Hazus Data Management
International Workflow For Newland (ND)

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Developed By:

Data 3.0 Professional Services
data30.com

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PROJECT OVERVIEW

In recognition of the importance of planning in mitigation activities, the Federal Emergency Management Agency (FEMA) has created Hazus - a powerful geographic information system (GIS) based disaster mitigation tool. This tool enables communities of all sizes to estimate damages and losses from hurricanes, floods and earthquakes to measure the impact of various mitigation practices that might help to reduce those losses.

Hazus is designed for use in USA. Universities and organizations around the world are investigating the potential use of Hazus as a regional solution to model natural disasters for local mitigation projects.

Data 3.0 and the National University of Singapore (NUS) participated in a Hazus International Proof of Concept (HIPOC) in July 2012. The goal was to integrate local data sets into Hazus to estimate losses resulting from sea level rise in Singapore. ArcGIS and FME tools were used to customize the building inventories to a Hazus compatible format. The building inventories were classified with the help of the Comprehensive Data Management System (CDMS) for flood hazard modelling. A flood depth grid representing a sea level rise of 2.8m was imported into a Hazus study region created for the Central Region of Singapore.

Several workflows were tested, and a HIPOC methodology was developed and demonstrated at NUS. HIPOC Version 2.1 was documented, but it is not for general consumption (it is specific to Singapore using NUS provided data).

The workflow presented in HIPOC Version 2.2 is intended for users who are seeking a 'generic' solution. The project is built for a synthetic country named Newland ('ND' - equivalent to a Hazus State) and a sub-region named Central Business District ('CBD' - equivalent to a Hazus County).

The goals of HIPOC Version 2.2 are loosely defined as:

1. The model must run in Newland. That means, we do not move Newland to USA, run the model, and then move Newland back while no one is looking.
2. Replace the US data with Newland data without breaking the model. That means, we do not move US Census Blocks/Tracts to Newland. Instead, we incorporate new Newland administrative boundaries.
3. No Hazus US counties or states: these tables need to be populated from the administrative boundaries defined in Item 2.
4. The Study Region is empty. The country, region, tracts and blocks are generated, but the user must fill them from local data sources (inventory and demographics).
5. The focus is flood. Flooding is one of the most common hazards around the world. Coastal flooding is associated with a rise in sea level over and above normal tidal action. The flood model supports the use of local flood boundaries (or depth grids) and Building Inventory that can be imported to international Study Regions.

HIPOC Version 2.2 is provided for reference purposes – use with caution. D3 is not responsible for the content of this workflow, the models, or the final loss estimates - there may be errors or omissions.

DESIGN CONSIDERATIONS

Hazus is intended for US consumption. It comes pre-packaged with US datasets, and can run "out of the box". Therefore, limits to this design will be encountered when adopting Hazus models to international projects:

1. The Hazus program cannot be altered – we do not have access to the core code. International customization is made to the supporting databases that Hazus uses as inputs to the model.
2. HIPOC Version 2.2 assumes that the user has a good understanding of the Hazus and CDMS data requirements. Other data management tools are needed to create Hazus compliant data from local sources. The HIPOC ETL tool of choice is FME (Safe Software).
3. A solid Hazus installation is required. To confirm, create a Study Region in Boone County, Indiana (without error conditions). See Appendix 3 – Hazus Hints.

Version 2.2 of the HIPOC is focused on creating a Study Region anywhere in the world. The Study Region is empty, but the structure will support inventory updates using CDMS. There are known design limitations:

1. ArcGIS Ver 10.0 FME tools no longer support ESRI Ver 8.1 geodatabases. The Hazus GDBs have been upgraded to 10.0. Hazus seems to support 10.0 GDBs, but further testing may be needed.
2. All source data must be projected to GSC-NAD83 before starting work. This is the only projection system that Hazus and CDMS support.
3. One country at a time. The 'ND' qualifier for Newland is used to replace the statewide tables for North Dakota. The Hazus StateFIPs is 38.
4. The HIPOC Ver2.3 inventory is structured for flood projects.
5. Aggregate models do not run (the inventory tables are empty). Therefore, Tract and Block boundaries are not needed to aggregate the inventory. One Tract and one Block will be created using the same geometry as the County in order to create the Study Region. Flood models may be run using imported UDFs.
6. The HIPOC Ver 2.2 workflow extends to creating the Study Region and running a flood analysis using a pre-defined flood depth grid. Workflows that describe other Hazus flood modeling options are project specific.
7. The provided World State and County boundaries are low resolution (to save space) and may need to be updated from higher quality local data sources.

Version 2.3 of the HIPOC has been extended beyond running a UDF flood event in Newland. The functional model is improved:

1. The HIPOC Ver 2.3 workflow describes updating the Demographics, General Building Stock (GBS) and Essential Facility (EF) inventories.
2. Multiple countries may be included for a regional solution.

Future versions of the HIPOC can be expanded on future international projects to include:

1. Other databases (e.g. Vehicles, Utility and Transportation) may be included.
2. Earthquake hazard models may be integrated.
3. Hurricane hazard models may be integrated.
4. Depth damage functions need to be developed outside of US construction types.
5. Customize the Hazus Study Region GUI by adding/modifying the records in syHazus.mdf (StateName = 'Singapore', StateID = 'SG', StateFIPs='99'). This did not work in HIPOC 2.3 – there are too many dependencies on the StateID in supporting databases.
6. High-rise buildings need special attention. NumStories > 9 are not supported in Hazus.

7. Multi-use building codes need special attention. Buildings used for RES1 (upstairs) and COM1 (ground floor) are commonplace, and not currently supported.

If Hazus is to be used as a global tool, certain design obstacles need to be overcome. These items cannot be entertained without support from the Hazus developers:

1. Hazus user guides and technical manuals are in English. There are no descriptions about customizing the Hazus databases for international users.
2. Hazus is limited to US$ and feet. Euros or Metres are not used anywhere.
4. The Hazus projection system is GCS-NAD83. GCS-NAD83 is not a global projection system. International implementations will be performed in GCS-WGS84
3. There are tricks to installing Hazus on a non-US device.
4. Technical support is always 12 hours away.
5. Sensitivity/validation studies needed to instill confidence in the modeling results.
8. Allow the user to modify/add State names in syHazus.mdf (e.g. StateName = 'Singapore', StateID = 'SG' and StateFIPs = '99').
9. Provide the ability for user-defined Study Region boundaries.

FILE MANAGEMENT

BACKUPS

Hazus does not support server-based workflows. Therefore, the HIPOC project is based on work that is performed on a local drive. User logins are sufficient - Hazus no longer requires administrator passwords.

Work performed on local PCs will need to be periodically secured. References to the Q:\drive in this workflow refer to the backup server used at D3:

C:\Projects\Hazus_Projects\Hazus_International	Local project drive
Q:\Hazus_International	Backup drive

PROJECT MANAGEMENT

Project documentation is stored under the following directory structure:

C:\Projects\Hazus_Projects\Hazus_International\Project_Management

Status	Project management progress reports
Advisory	Reference materials for HIPOC implementations
Workshops	Meetings and workshop materials

DATA MANAGEMENT

Data sets are managed under the following directory structure:

C:\Projects\Hazus_Projects\Hazus_International\Data_Management

Data_Sources	Pre-processed data
Hazus_Updates	Updated statewide tables
Models	Analysis data and results

DATA SOURCES

Data sources received from various agencies are organized by geography:

…\Data_Management\Hazus_International\Data_Sources

ND	Newland national data

HAZUS_UPDATES

Updated Hazus inventory is organized by country and inventory type. The Hazus_Updates folder is where the Hazus inventory is replaced from the data in \Data_Sources

…\Data_Management\Hazus_International\Hazus_Updates\ND

User_Defined_Facilities	UDF MDBs for import into Hazus
Tools	FME scripts to create the CDMS import MDBs
Templates	Empty MDB schemas
Statewide	ND Hazus tables
Working	Temporary area for work in progress

MODELS

The \Models folder contains the results of the analysis as well as the hazard and inventory datasets used as inputs. Modeling is performed in a Hazus Study Region built by country, state or County.

…\Data_Management\Models

ND	Newland model results
Template	Templates and tools used for next HIPOC

…\Data_Management\Models\ND\

Analysis	Updates to hazard and inventory databases
HPR	Exported Hazus Study Regions
MXD_Documents	Production and final mapping documents
Reports	Documents and logs

ANALYSIS

Subfolders under \Models contain tools, documents and reports used in the development of the model.

…\Data_Management\Models\ND\

Analysis\Flood	Flood hazard updates and loss results
Analysis\Inventory	Building Inventory
Analysis\Tools	Data processing tools
Reports	Output maps, tables, reports and logs
Tools	FME scripts used to create BI GDBs
Working	Temporary area for work in progress
Reports\Workflow	Project workflow document

DOCUMENT MANAGEMENT

The workflow document is maintained by D3 for use by both teams working on the Pre-Disaster Mitigation (Hazus) project for HIPOC. The name of the file is:

…\Workflow\ND_CBD_Workflow_v<V>_<R>.docx

where

<V>	Version number 1-9
<R>	Revision number 1-9

The following abbreviations are used throughout the document:

[TBD]	To Be Determined
[PIO]	Process Improvement Opportunity
[Name]	Contributions required by …
[Rev]	Major revision marker
[Note]	Miscellaneous hints to the reader

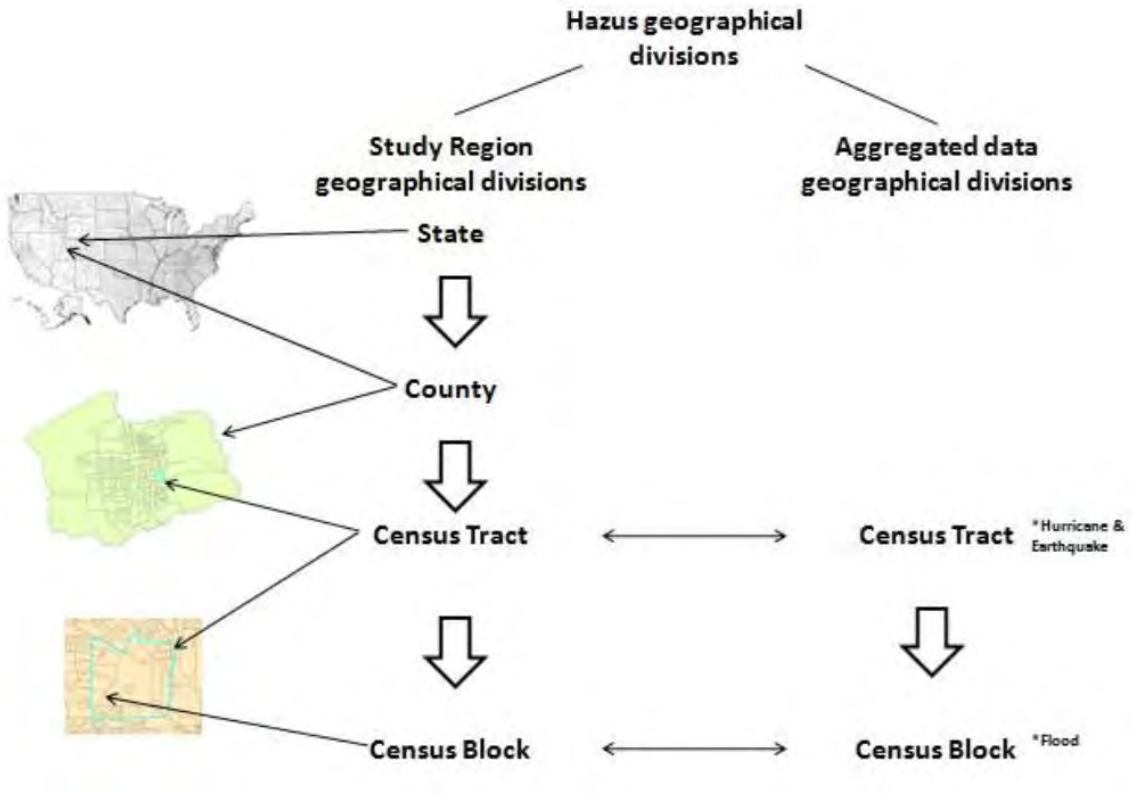
Versions are incremented with each project milestone.

Version	Date	Change
2.2	12-Aug-2014	Document started

WORKFLOW OVERVIEW

Generic tasks to update Hazus v2.1 databases to support flood models in Newland are described below. The user will be able to create Study Regions inside their home countries based upon the workflow and tools developed for CBD.

WORKFLOW DIAGRAM



TASK 1 PREPARE HAZUS DATABASES

1. Refresh Boundaries
2. Add State Boundary for Newland
3. Add County Boundary for CBD
4. Add Census Block and Tract Boundaries for CBD
5. Install Hazus databases for Newland

Outputs:
syBoundary.mdb
ND bndrygbs.mdb
ND EF.mdb | UTIL.mdb | TRNS.mdb | HPLF.mdb

TASK 2 PREPARE CBD DATA SOURCES

1. Download source data from Newland FTP site
2. Copy Models\Template folder
3. Prepare template documents

Outputs:
Models\CBD

TASK 3 BUILDING INVENTORY

1. Create Improvements from local data sources
2. Create Building Inventory from Improvements.

Outputs:
ND_CBD_BI_GDB.mdb

TASK 4 UPDATE HAZUS INVENTORY

1. Create a 'Hazus ready' UDF database from CBD Building Inventory
2. Create a Flood Study Region for CBD
3. Import UDFs into CBD Study Region

Outputs:
ND_CBD_Hazus_Import_UDF.mdb

TASK 5 HAZUS FLOOD ANALYSIS

1. Import Flood Depth Grid
2. Create Flood Scenario
3. Run Flood Analysis
4. Export Results

Outputs:
ND_CBD_FL_Analysis_GDB.mdb
ND_CBD_FL_UDF.hpr

TASK 1 – PREPARE HAZUS DATABASES

Hazus-2.1 statewide datasets will be updated before the local Study Regions can be made. Demographics, General Building Stock and Essential Facility databases will be refreshed (all records deleted) in Task 1. Boundary records for Newland will be imported. Inventory records for CBD will be imported.

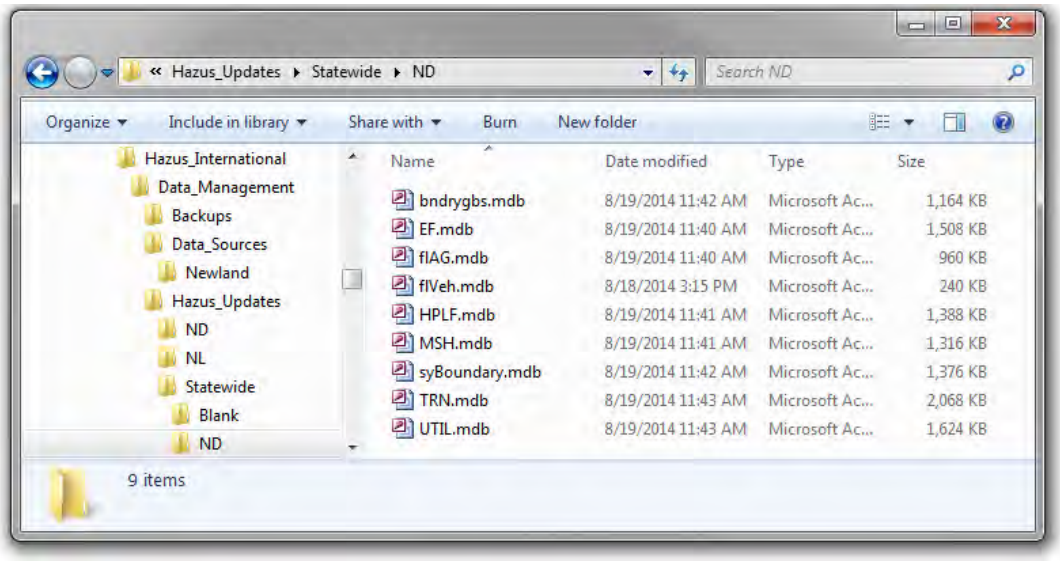
TASK 1.1 - PREPARE HAZUS BOUNDARIES

TASK 1.1.1 – REPLACE HAZUS BOUNDARIES WITH WORLDWIDE BOUNDARIES

Pre-populated Hazus databases that can be used world-wide are provided in \World. International State and County boundaries have been added, but the inventory is blank.

Blank Hazus databases are provided in \Blank. The desired records from \World are exported to \Blank. The user must populate the empty Block and Tract records.

- Copy \Blank*.mdb to \ND

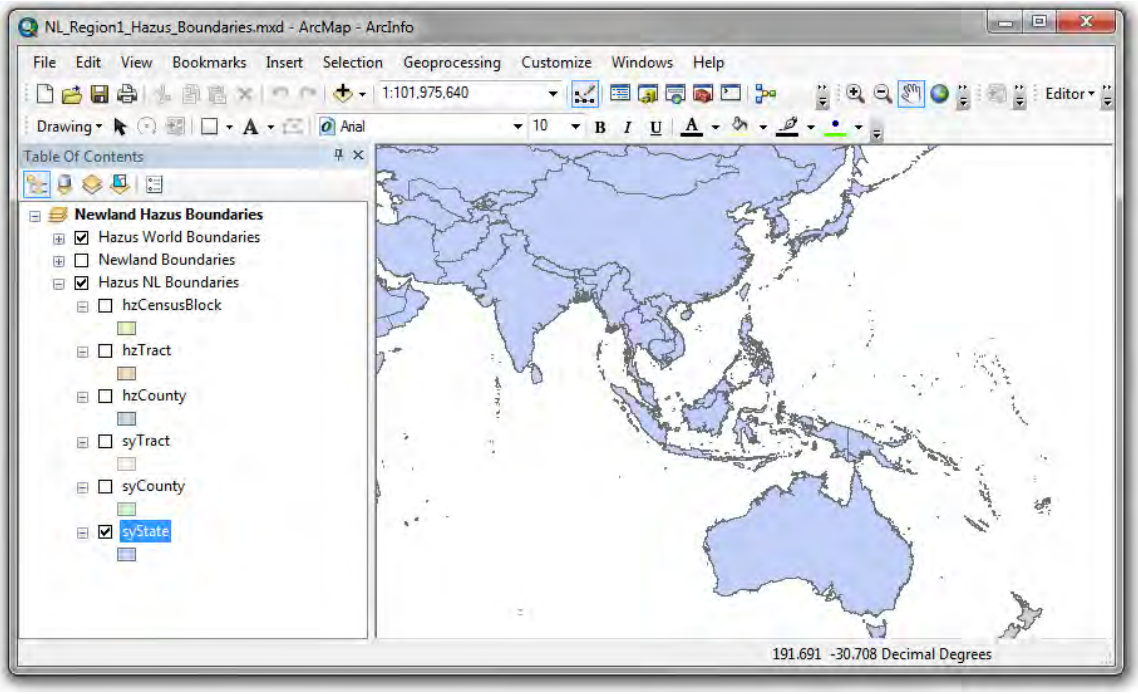


[Note] For users wanting to create their own World statewide tables, copy the default Hazus statewide tables for a representative state and delete the records from each database. In this case, users will need to add their own State and County boundaries.

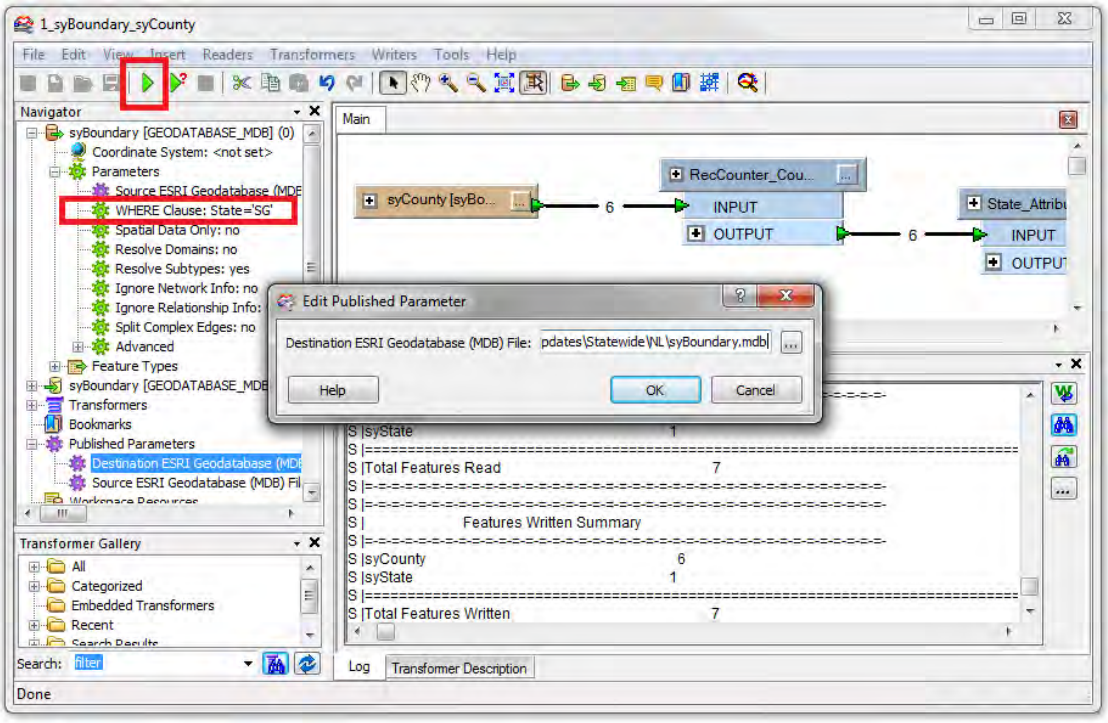
TASK 1.1.2 – RELATE STATE BOUNDARIES TO COUNTY BOUNDARIES

Not all pre-populated countries (226) and regions (3,203) will be needed. The countries of interest will be identified, and the associated interior regions will be related. For the IHPOC, the Study Area will be Singapore (the corresponding State will be Newland – 'ND').

- Open \Models\ND\MXD_Documents\ND_CBD_Hazus_Boundaries.mxd



- Add the ND_CBD_Hazus_Boundaries.tbx toolkit from \Hazus_Updates\ND\Tools\
- Edit the tool named 1_syBoundary_syCounty. Modify the WHERE Clause to the country (or countries) to be modelled. Set the Destination Geodatabase to the syBoundary.mdb to be updated. Run the tool.



- The tool will copy selected syState and related syCounty records from \World to \ND. In the case of IHPOC, the Newland State and County boundaries will be exported and following attributes populated:
  syState | StateFips = '38'
  syState | HUState = '0' (Hurricane model not supported in HIPOC)
  syState | NumCounties = 'nnn' (the record count in syCounty where State = 'ND')
  syCounty | CountyFips = StateFips & 'nnn'

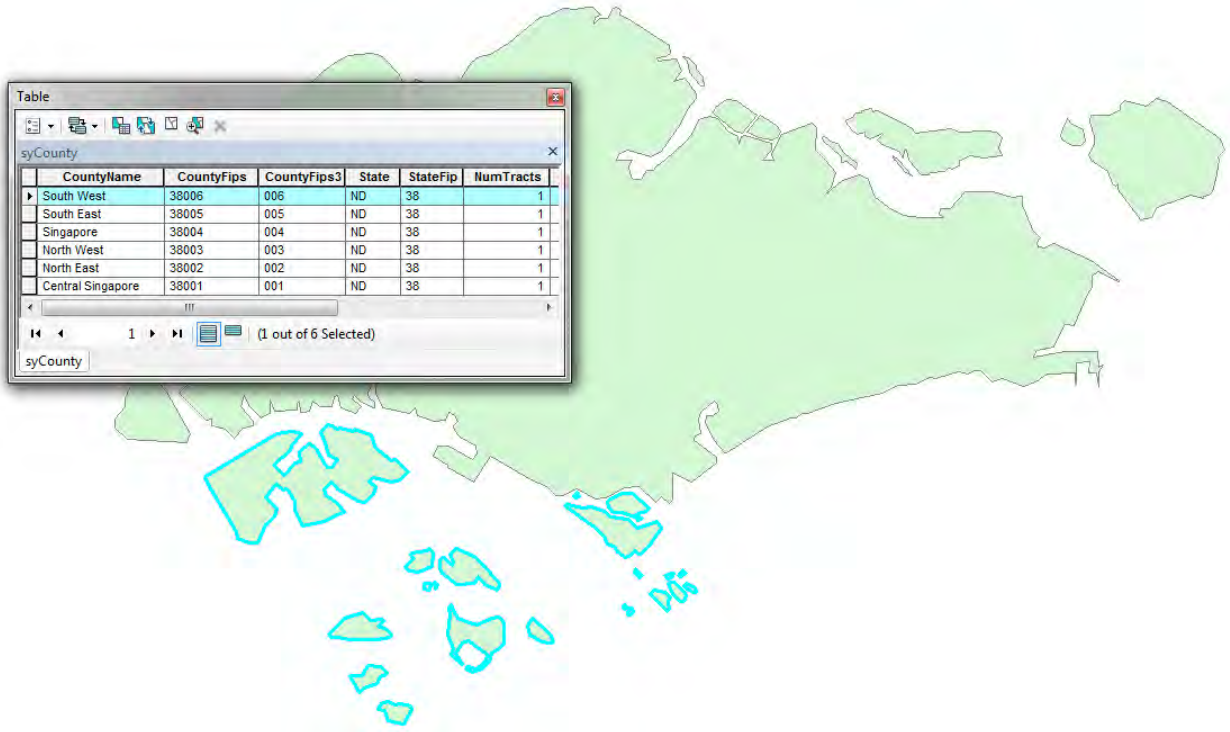


Table
syCounty
CountyName | CountyFips | CountyFips3 | State | StateFip | NumTracts
South West | 38006 | 006 | ND | 38 | 1
South East | 38005 | 005 | ND | 38 | 1
Singapore | 38004 | 004 | ND | 38 | 1
North West | 38003 | 003 | ND | 38 | 1
North East | 38002 | 002 | ND | 38 | 1
Central Singapore | 38001 | 001 | ND | 38 | 1
1
(1 out of 6 Selected)
syCounty

- Save the FME log file to
  …\Hazus_International\Data_Management\Models\ND\Reports\Logs
  ND_FME_syBoundary_syCounty_140819.txt

[Note] Removing unwanted countries and regions from syBoundary.mdb is optional. However, the databases will be more efficient, and the Study Region creation process streamlined if the Hazus tables are restricted to the Study Area limits.

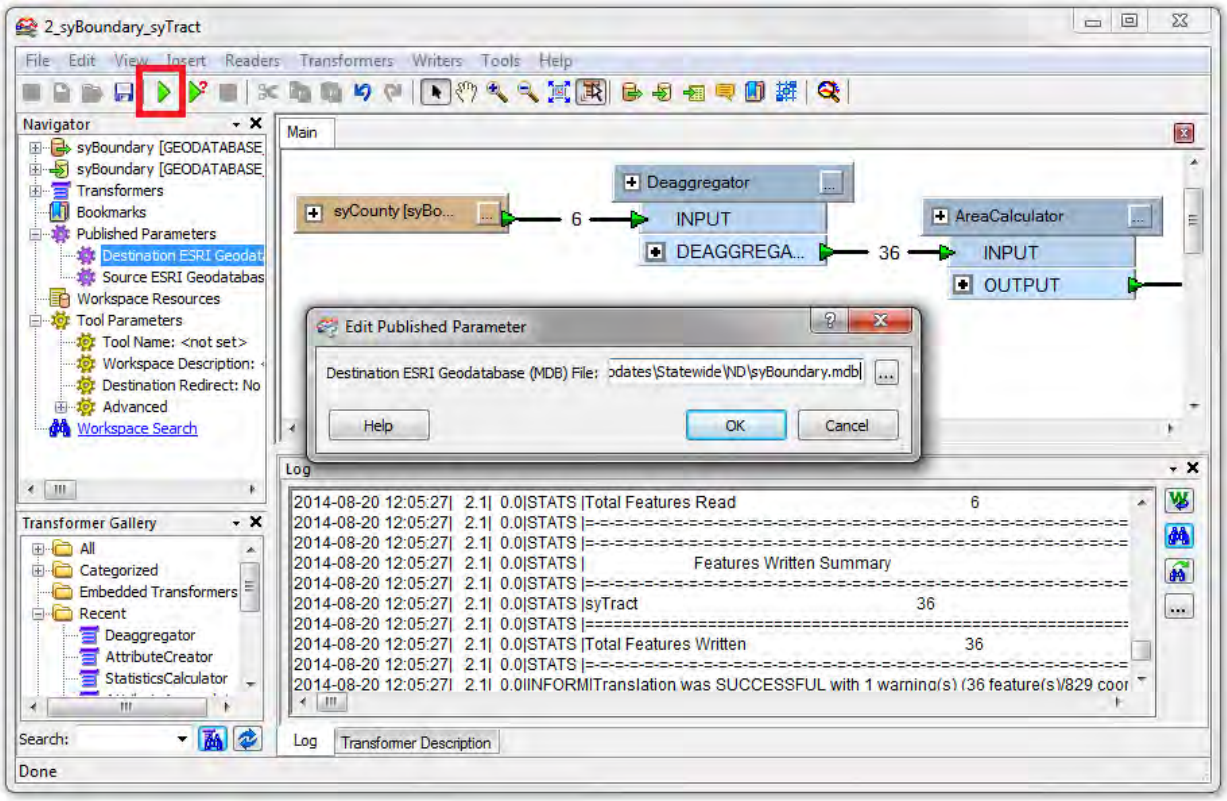
[Note] Multiple countries can be selected if a regional solution is needed.

[Note] For users wanting to write their own ETL tools, modify syBoundary.mdb to remove all records outside of the Study Area.

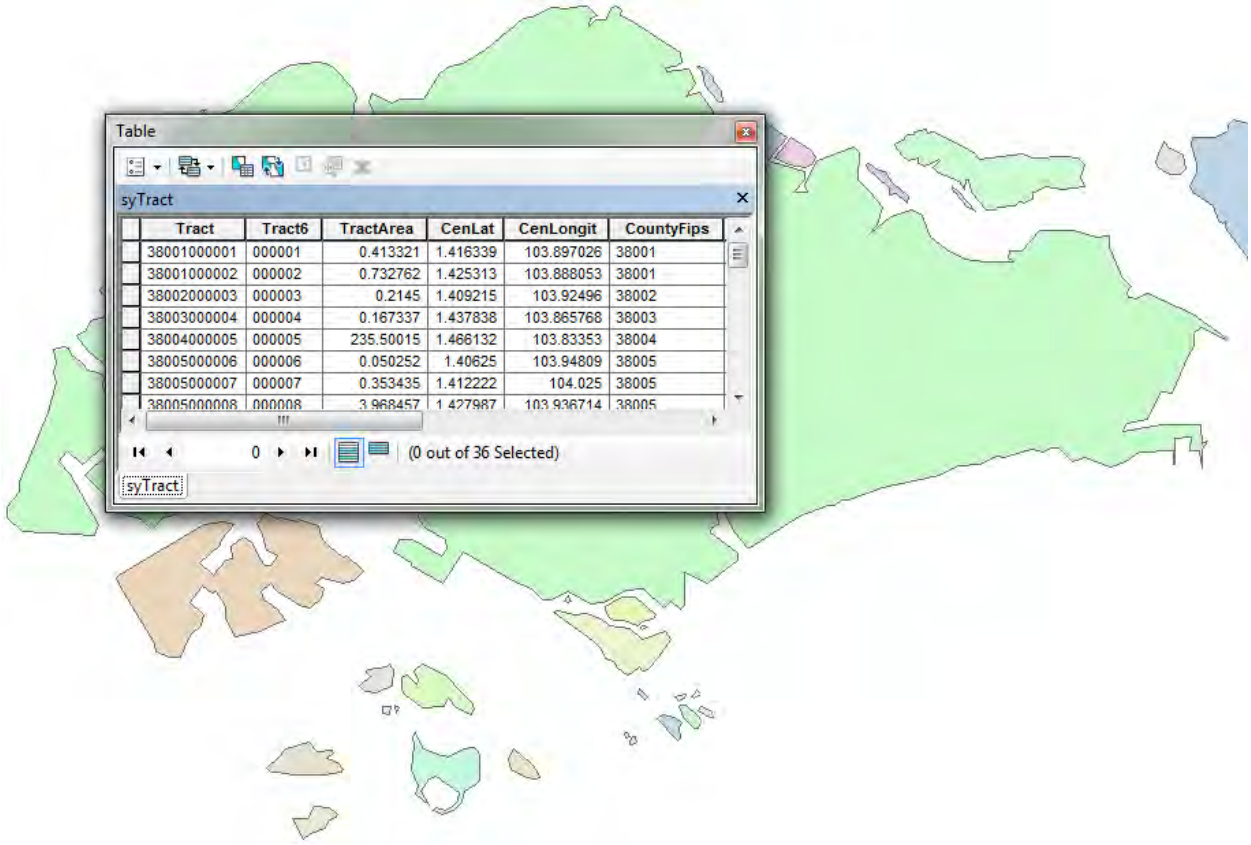
TASK 1.1.3 – RELATE COUNTY BOUNDARIES TO TRACT BOUNDARIES

Tract boundaries are stored in syBoundary. Tract boundaries will be generated from the regional County boundaries (one Tract per County).

- Open \Models\ND\MXD_Documents\ND_Hazus_Boundaries.mxd
- Edit the tool named 2_syBoundary_syTract. Set the Destination Geodatabase to the syBoundary.mdb to be updated. Run the tool.



- The tool will export the regional boundaries to \ND\syBoundary | syTract. The County boundaries are deaggregated (polygon parts are made into separate Tracts) and the following attributes populated:
  - syTract | Tract = '38001000001' through '3800n00000x'
  - syTract | CountyFips = '38001' through '3800n'
  - syTract | Tract6= '000001' through '00000x'
  - syTract | TractArea = Shape_Area * 4,754 (in sq miles)

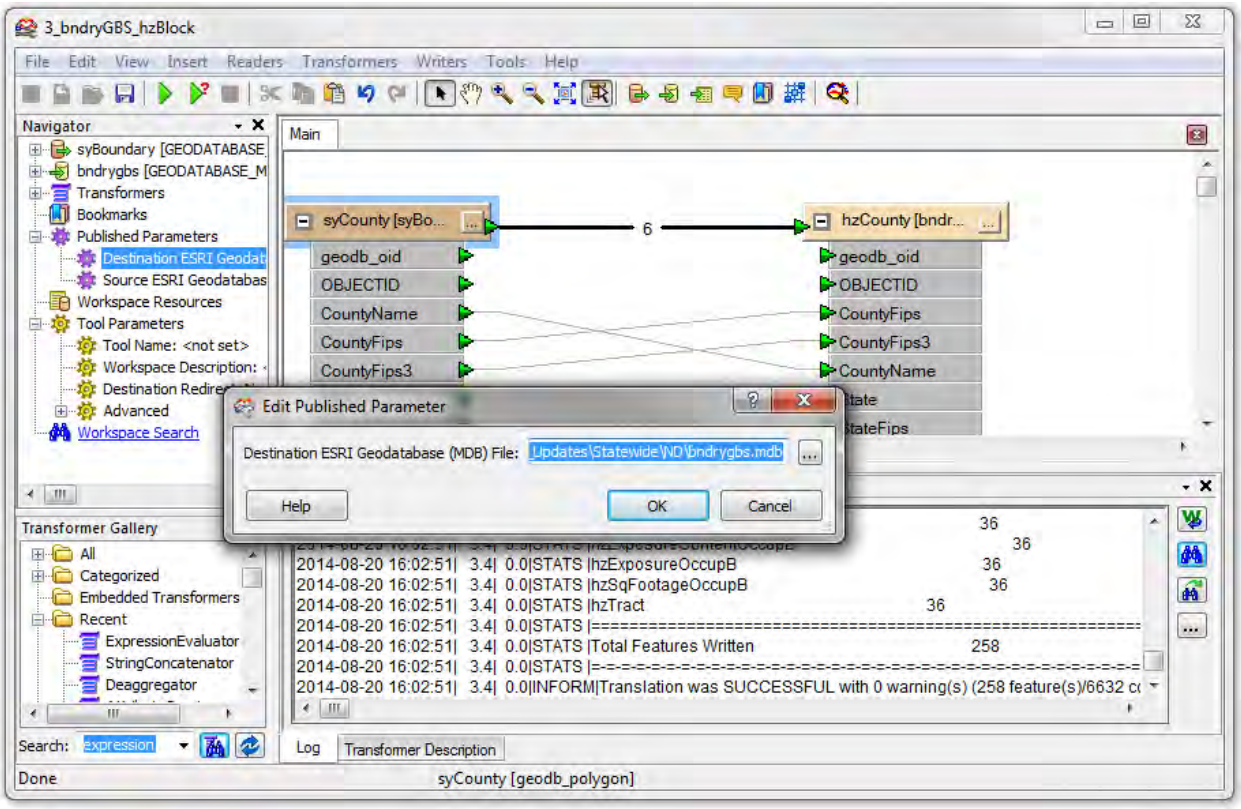


- Save the FME log file to
  …\Hazus_International\Data_Management\Models\ND\Reports\Logs
  ND_FME_syBoundary_syTract_140819.txt

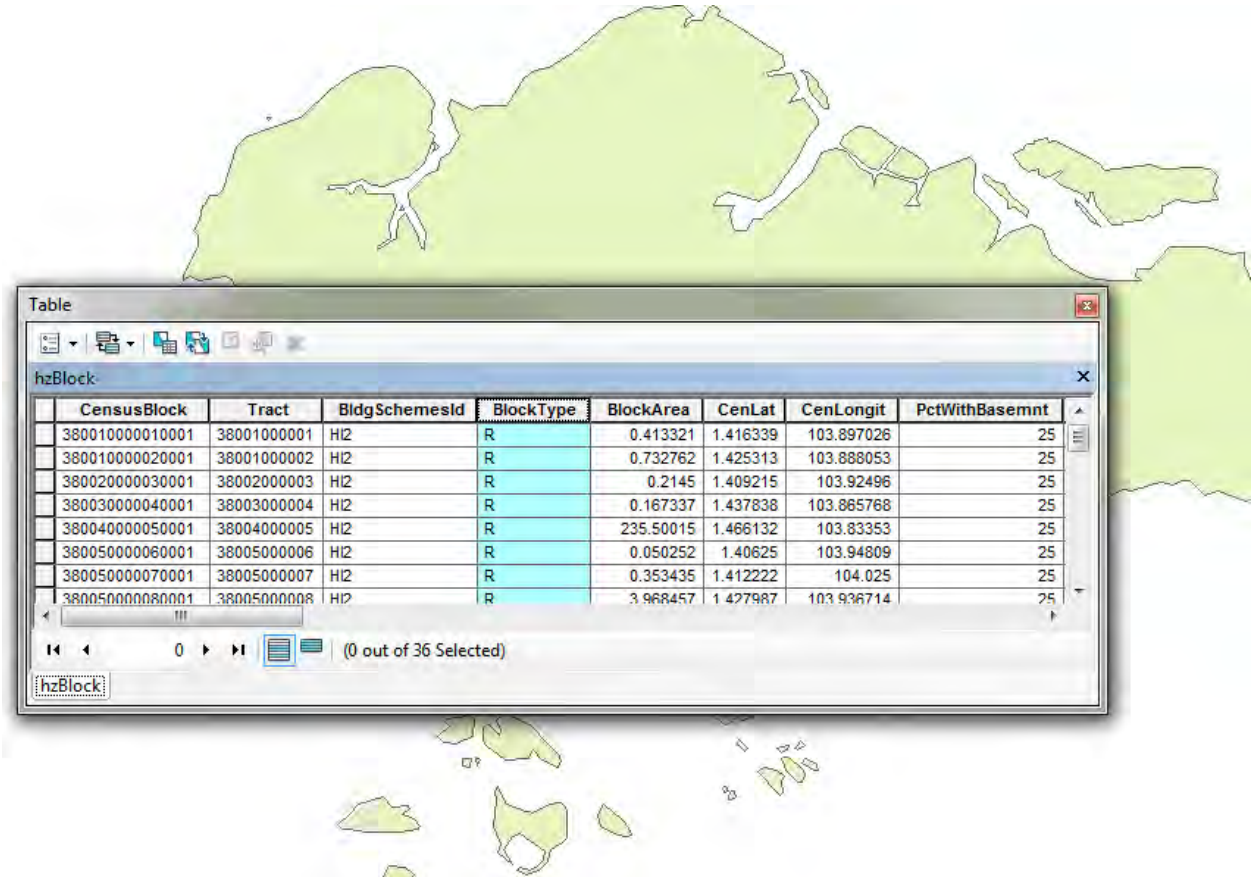
TASK 1.1.4 – RELATE TRACT TO BLOCK BOUNDARIES

Tract and Block boundaries are stored in bndrgygbs.mdb, and they need to be generated before a Study Region can be made. Tract and Block boundaries will be defined by the syTract boundaries previously created in syBoundary (one Block per Tract).

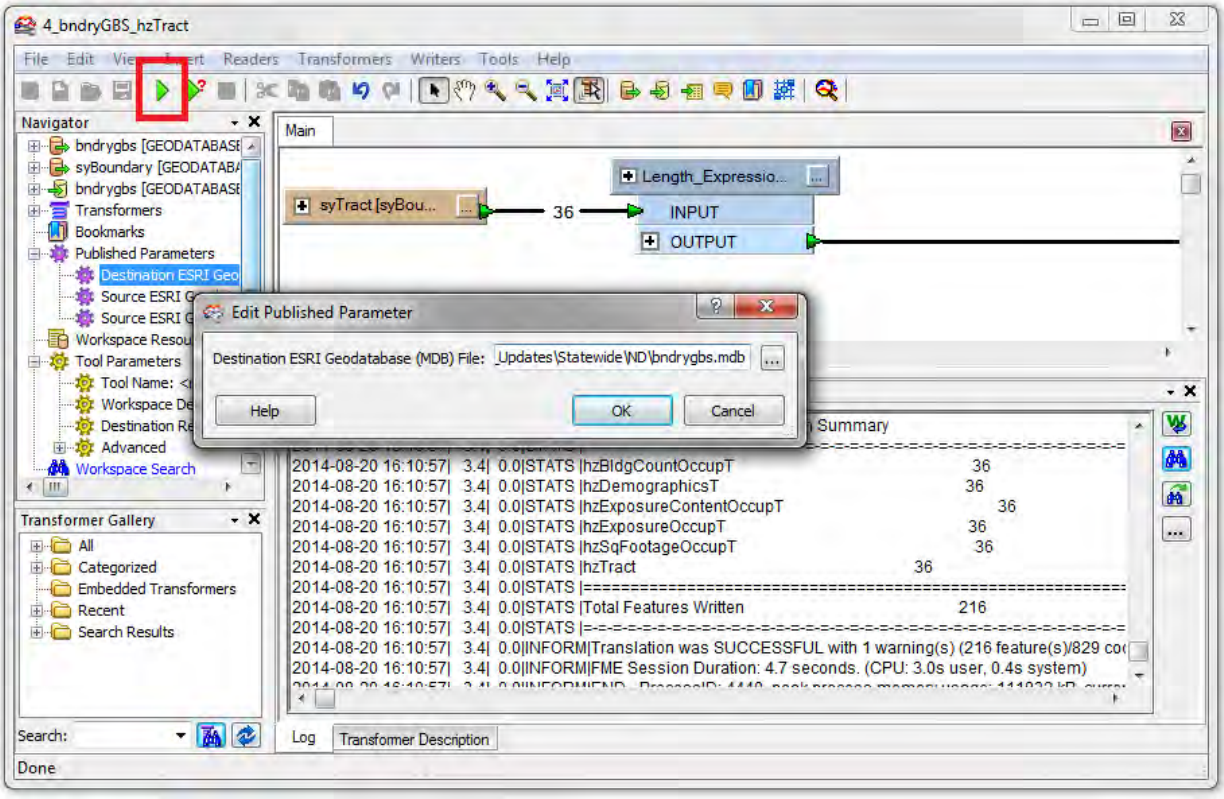
- Open \Models\ND\MXD_Documents\ND_Hazus_Boundaries.mxd
- Edit the tool named 3_bndryGBS_hzBlock. Set the Destination Geodatabase to the bndryGBS.mdb to be updated. Run the tool.



- Save the FME log file to
  …\Hazus_International\Data_Management\Models\ND\Reports\Logs
  ND_FME_bndryGBS_hzBlock_140819.txt



- Edit the tool named 4_bndryGBS_hzTract. Set the Destination Geodatabase to the bndryGBS.mdb to be updated. Run the tool.

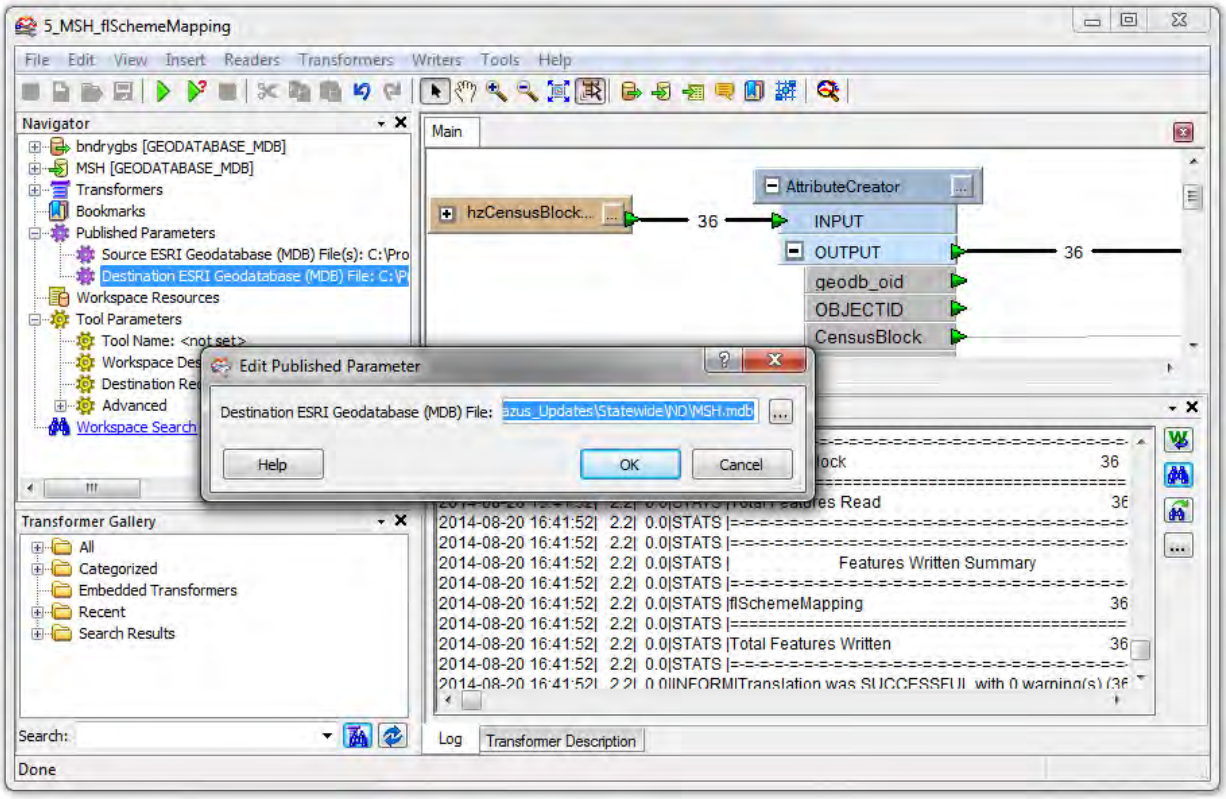


- Save the FME log file to
  …\Hazus_International\Data_Management\Models\ND\Reports\Logs
  ND_FME_bndryGBS_hzTract_140819.txt

TASK 1.1.5 – UPDATE MAPPING SCHEMES

Each Block has a corresponding record in MSH.mdb to show the distributions of building types and .

- Open \Models\ND\MXD_Documents\ND_Hazus_Boundaries.mxd
- Edit the tool named 5_MSH_SchemeMapping. Set the Destination Geodatabase to the MSH.mdb to be updated. Run the tool.



- Save the FME log file to
  …\Hazus_International\Data_Management\Models\ND\Reports\Logs
  ND_FME_MSH_SchemeMapping_140819.txt

The \ND statewide tables are now formatted to run with Hazus. They may be used to create a Study Region, but they will be empty. All tables have been populated with default values, and must be updated using local data sources. Data population strategies are provided in HPOC Ver 2.3.

The following sections describe how to model a flood event using local Building Inventory.

TASK 2 – PREPARE CBD DATA SOURCES

The General Building Stock and Essential facility databases were flushed out in Task1. The GBS and EF records will be updated for CBD using local data sources in Task2.

A modeling folder structure will be setup that contains the source materials, mapping templates, tools, source data sets and final reports.

TASK 2.1 - PREPARE DATA SOURCES

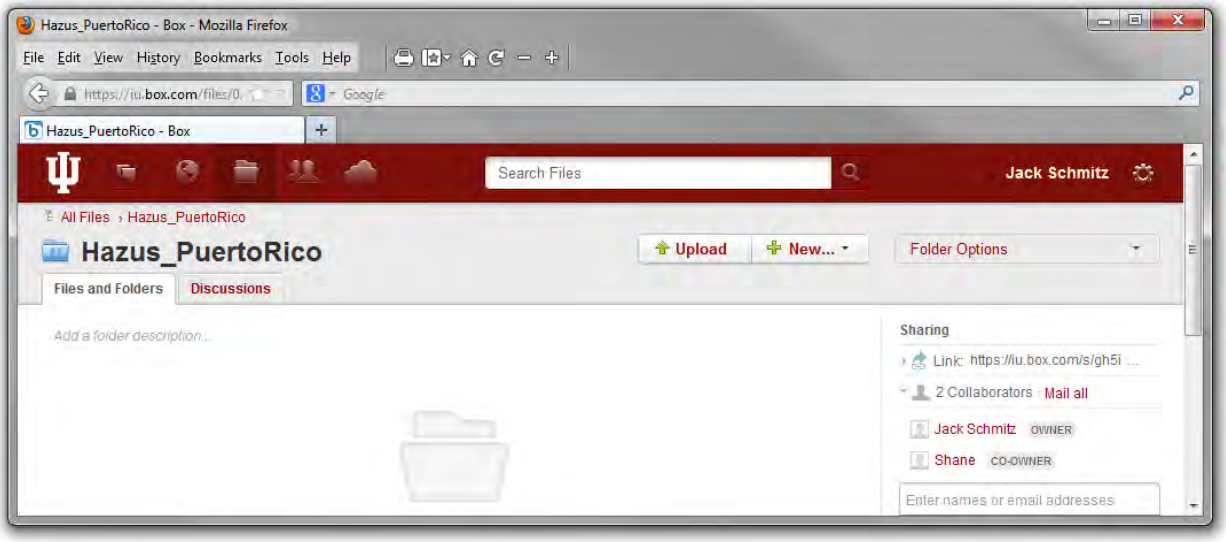
TASK 2.1.1 –DATA EXCHANGE

Box.net is the preferred HIPOC data portal. Typical data sets to exchange include:

- Inventory sources (Building Footprints)
- Hazard sources (depth grids).

The HIPOC data portal can be accessed at the following URL. It is password protected:

https://box.com/hipoc/gh5iwbcdxf5tlejkppw8



TASK 2.1.2 –DATA BACKUPS

The \Tools folder contains scripts that will be used to process the County datasets. A .bat script is provided to make incremental backups to Q:\drive.

- Rename:
  From: ND_County_Backups.bat
  To: ND_CBD_Backups.bat
- Open ND_CBD_Backups.bat in Notepad and replace all occurrences:
  From: <Region>
  To: active County name (e.g. “CBD”)
- Run the BAT file at significant project milestones to back-up work to the Q:\drive. The script also creates directory listings of the current files and folders under:
  …\Models\CBD\Reports\Logs

TASK 2.1.3 – DATA SOURCES

Data Source folders have been created as a repository for the raw GIS databases provided by Newland and other GIS vendors. The data sources are organized by data provider and date. Data source folders contain the original data – all data processing events occur in the modeling folders.

- Copy the source data from FTP to
  …\Hazus_International\Data_Management\Data_Sources\
  <Vendor_Name>\<yymmdd>\

TASK 2.2 - PREPARE MODELS

Model folders are provided to house the local inventory, hazard definitions and analysis results for CBD.

TASK 2.2.1 - MODEL FOLDERS

Model folders have been created for the data processing and modeling activities. The models are derived from a standard Template. Each template contains the folder structures and tools used to prepare the source data and model data for each County. The Template contains the knowledge base for the project – it is updated on the Q:\ drive as processes are improved.

- Copy the source data template from
  Q:\ND HIPOC\Data_Management\Data_Sources\Models\Template
  to
  …\Hazus_International\Data_Management\Data_Sources\Models\CBD
- Copy the modeling template from
  Q:\ND HIPOC\Data_Management\Models\Models\Template
  to
  …\Hazus_International\Data_Management\Models\Models\CBD

TASK 2.2.2 - TEMPLATES

Template documents need to be setup for each County. Rename all templates and change the file properties. Modify the contents to reflect the active model (CBD).

- Rename:
  From: ND_County_*.*
  To: ND_CBD_*.*
- Update the File Properties on all CBD documents
  Subject: CBD
  Author: <Enter your name here>
  Comments: 2014 Pilot
  Category: HIPOC Newland
  Company: D3 | Newland
- Open each document in Word and replace all occurrences:
  From: <Region>
  To: The active County name (e.g. “CBD”)

TASK 2.2.3 - WORKING FOLDERS

Working folders and GDBs are provided as temporary data stores to process intermediate feature classes. Working folders or files are temporary – they may be removed after the Hazus inventory is updated:

…\Models\CBD\Analysis\Working
ND_CBD_Working_GDB.mdb

…\Models\CBD\Hazus_Updates\Working
ND_CBD_Working_GDB.mdb

TASK 2.3 - INSTALL HAZUS DATABASES

Any changes made to the Hazus statewide databases during the course of this project will be version controlled. Details of the changes will be documented:

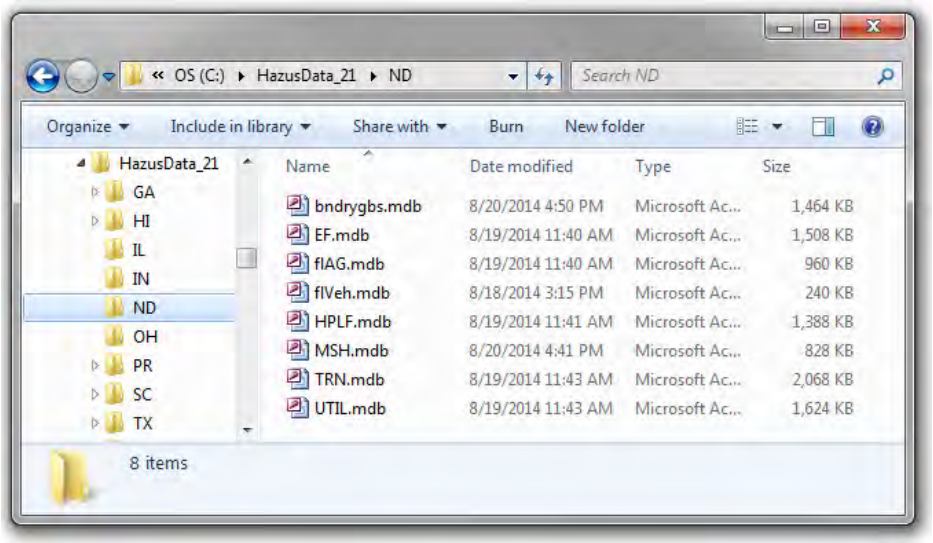
…\Models\CBD\Reports\Logs\
ND_CBD_Hazus_Updates_<yymm>.doc
ND_CBD_Hazus_Updates_<yymm>.xls

Changes to the Hazus Study Region databases are not version controlled. The most current Hazus databases must be installed on all local PCs where Hazus modeling will be performed.

TASK 2.3.1 - REPLACE DEFAULT DATABASES

The Hazus default General Building Stock specific database must be replaced with the updated database provided by Newland before creating the Study Region.

- Updated Hazus databases for Newland are provided in:
  …\Hazus_Updates\Statewide\ND\
- Copy the updated boundary database from:
  …\Hazus_Updates\Statewide\ND\syBoundary.mdb
  to:
  C:\HazusData_21\
  syBoundary.mdb
- Copy the remaining inventory databases from:
  …\Hazus_Updates\Statewide\ND*.mdb
  to:
  C:\HazusData_21\ND\
  *.mdb

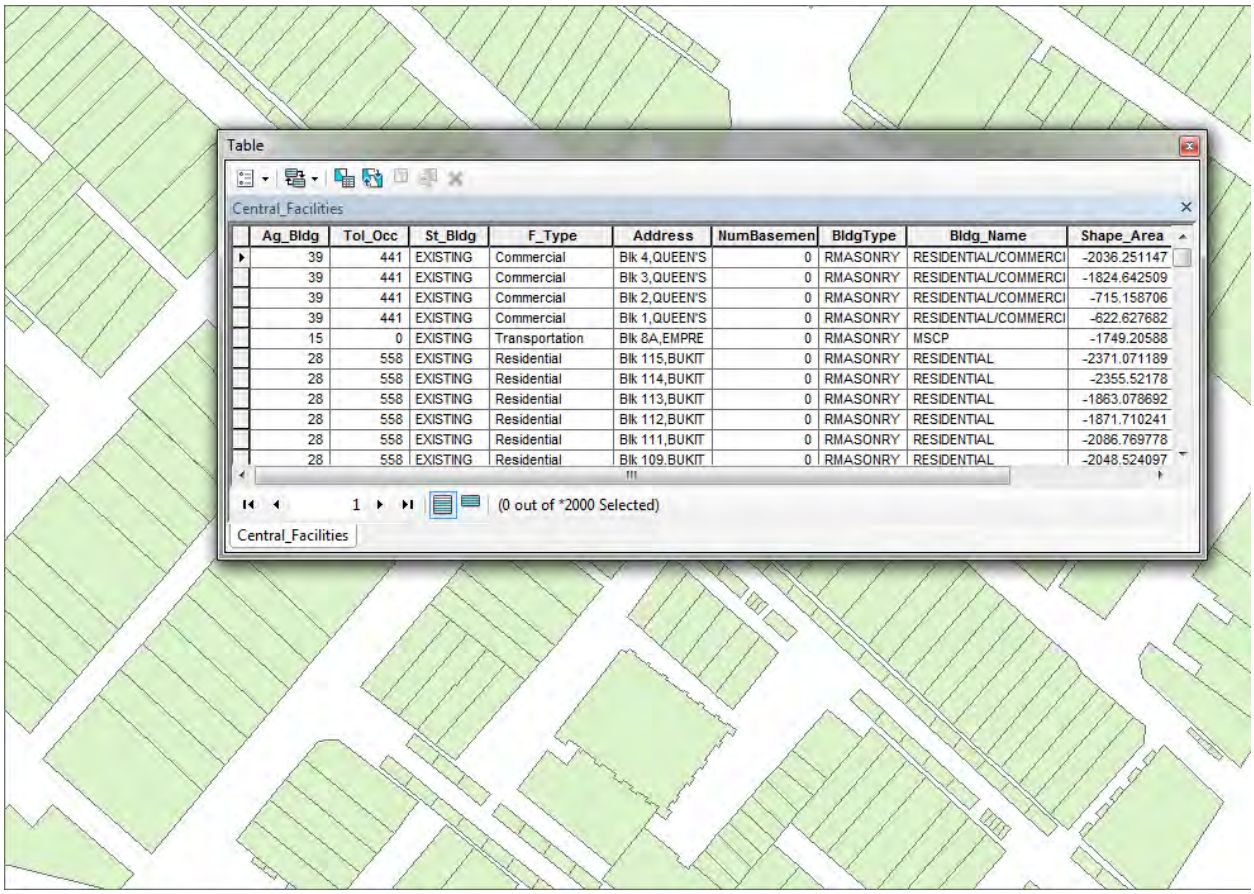


TASK 3 – BUILDING INVENTORY

Building Inventory is considered to be the most current and accurate database of the structures to be modeled by Hazus. It is often created by linking the parcel centroids with tax assessor improvement records. For the HIPOC, Building Inventory is generated from building footprints.

The workflow to create Building Inventory starts with building footprints which is maintained by Newland. Not all desired fields have been populated (typical), so missing values will be derived or defaulted.

Improvements represent the foundation feature class for the creation of Building Inventory. It is created by populating values with best available data.



Ag_Bldg	Tol_Occ	St_Bldg	F_Type	Address	NumBasemen	BldgType	Bldg_Name	Shape_Area
39	441	EXISTING	Commercial	Blk 4,QUEEN'S	0	RMASONRY	RESIDENTIAL/COMMERCI	-2036.251147
39	441	EXISTING	Commercial	Blk 3,QUEEN'S	0	RMASONRY	RESIDENTIAL/COMMERCI	-1824.642509
39	441	EXISTING	Commercial	Blk 2,QUEEN'S	0	RMASONRY	RESIDENTIAL/COMMERCI	-715.158706
39	441	EXISTING	Commercial	Blk 1,QUEEN'S	0	RMASONRY	RESIDENTIAL/COMMERCI	-622.627682
15	0	EXISTING	Transportation	Blk 8A,EMPRE	0	RMASONRY	MSCP	-1749.20588
28	558	EXISTING	Residential	Blk 115,BUKIT	0	RMASONRY	RESIDENTIAL	-2371.071189
28	558	EXISTING	Residential	Blk 114,BUKIT	0	RMASONRY	RESIDENTIAL	-2355.52178
28	558	EXISTING	Residential	Blk 113,BUKIT	0	RMASONRY	RESIDENTIAL	-1863.078692
28	558	EXISTING	Residential	Blk 112,BUKIT	0	RMASONRY	RESIDENTIAL	-1871.710241
28	558	EXISTING	Residential	Blk 111,BUKIT	0	RMASONRY	RESIDENTIAL	-2086.769778
28	558	EXISTING	Residential	Blk 109,BUKIT	0	RMASONRY	RESIDENTIAL	-2048.524097

The high-level workflow to create Building Inventory is described below:

Task 3.1 – Prepare Improvements

Run the FME script called Cental_Facilities_2_Improvements

- Creates Improvements at the centroid of each building footprint
- Joins Permits to Building Points to populate 'blank' Hazus fields
- Calculates Building Area and NumStories
- Calculates Building Cost from Building Area
- Converts Cali to Hazus Occupancy Code
- Project Improvements to GCS_NAD83

Task 3.2 – Migrate Building Inventory

Run the FME script called Improvements_2_BI
Creates Building Inventory from Improvements
Converts all values to Hazus domains

TASK 3.1 - PREPARE IMPROVEMENTS

[Note] The workflow to create Improvements will vary from country to country, and cannot be standardized. The source databases to be used for Improvements need to be prepared for each Study Region. Skeleton tasks are provided for reference purposes only.

Improvements is a point feature class that represents the structures within CBD to be modeled. Improvements are unique to Newland, and represent the merging of the best available sources into a common feature class. The goal of Task 3.1 is to extract as much information as possible for each building record. Attributes will be populated where they exist. Attributes will be derived or defaulted where they do not exit.

The Task 3.1 schema/tools/workflow is customized for each project. The Improvements schema/tools/workflow must also be customized for each region if the source data structure (or content) is not consistent within all Newland Regions.

Improvements are used to create Building Inventory. Building Inventory is "generic" – it is a defined schema that has been designed to work with Hazus and other modeling tools across all projects.

TASK 3.1.1 - DOWNLOAD DATA SOURCES

Building Footprints have been posted to the HIPOC FTP site. Download the Newland GDB to the local \Data_Sources folder:

- Download Footprints to:
  …\Data_Sources\Newland\Inventory\
  NL_Region1_Buildings_GDB.mdb

TASK 3.1.2 – CLIP FOOTPRINTS TO CBD BOUNDARY

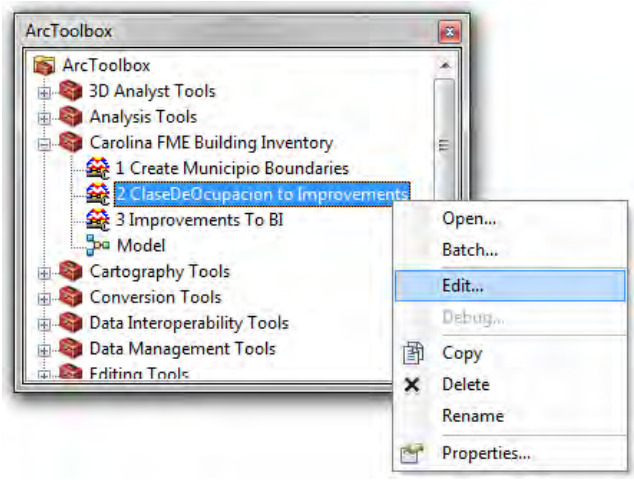
Region1 building footprints (polygons) must be clipped to the CBD boundary and converted to points (centroids). A working folder and GDB has been setup to prepare the source data.

- Open the MXD named:
  …\Models\CBD\MXD_Documents
  ND_CBD_BI_Updates.mxd
- ArcToolbox | Analysis Tools | Extract | Clip to export Region1_Buildings within the CBD boundary to the Working GDB. Send the output to:
  …\Models\CBD\Analysis\Working
  ND_CBD_Working_GDB.mdb
  ND_CBD_Working_GDB.mdb | CBD_Footprints
- ArcToolbox | Data Management Tools | Features | Feature To Point to export CBD_Footprints to the Working GDB. Send the output to:
  …\Models\CBD\Analysis\Working
  ND_CBD_Working_GDB.mdb
  ND_CBD_Working_GDB.mdb | CBD_Buildings

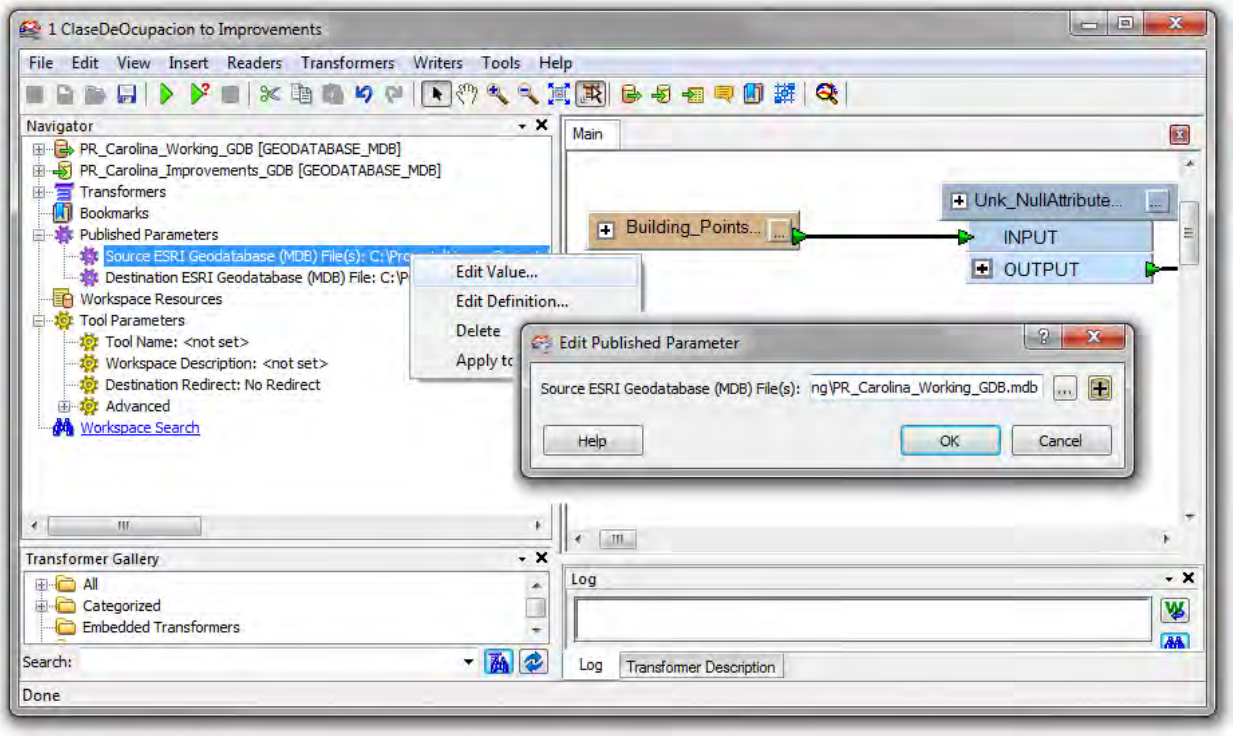
TASK 3.1.3 – CONVERT BUILDINGS TO IMPROVEMENTS

CBD_Buildings will be combined to a common Improvements feature class. Missing values will be populated. Populated values will be migrated – unpopulated values will be defaulted or derived from other values. The scripts are setup for CBD, but may be modified for other Regions.

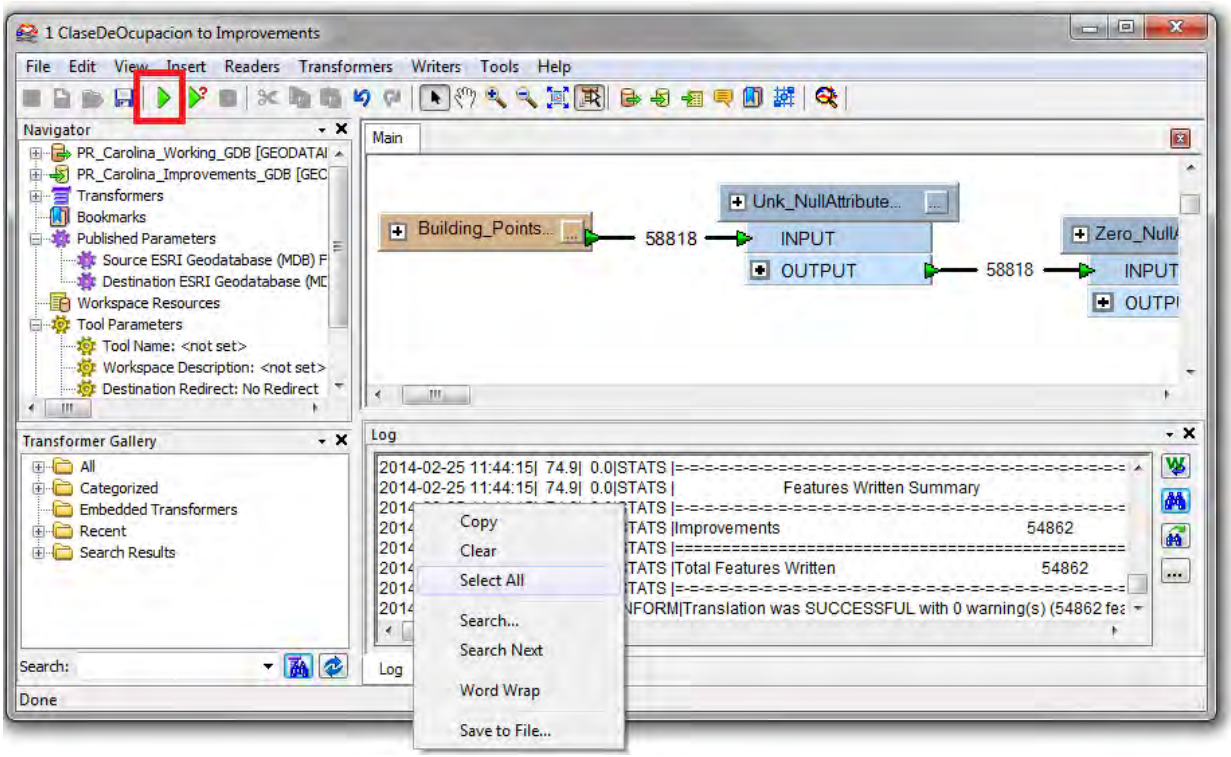
- Add the HIPOC CBD FME BI toolbox to ArcTools from:
  …\Models\CBD\Tools\ND_CBD_FME_BI.tbx
- Right-click | Edit the 2_Buildings_2_Improvements tool to open up the FME workbench.



- Set the input Published Parameters | Source to:
  …\Models\CBD\Analysis\Working\
  ND_CBD_Working_GDB.mdb
- Set the output Published Parameters | Destination to:
  …\Models\CBD\Analysis\Inventory\Improvements\
  ND_CBD_Improvements_GDB.mdb



- Run the script and review the log file to make sure that CBD_Buildings records were processed correctly.
- Add CBD Improvements to the MXD and review the results.
- If all OK, save the log file to
  …\Models\CBD\Reports\Logs\
  ND_CBD_FME_Buildings_To_Improvements_<yymmdd>.txt



- Exit the FME workbench and save the changes to the ND_CBD_Buildings_To_Improvements tool.

The algorithms used in the Buildings_2_Improvements FME script are provided in Appendix 3. In general:

- Filter out unwanted records (Vacant and Abandoned)
- Filter our “non-structures” (e.g. Swimming pools, patios, sheds, parking lots etc…)
- Convert Area to sq feet and Cost to US dollars
- Calculate NumStories = Height * 3.28 / 10
- Calculate BldgArea = Area * NumStories
- Calculate FirstFloorHt = Elev * 3.28
- Normalize Occupancy Codes based upon FType
- Refine RES occupancies from numbers of occupants
- Calculate YearBuilt = AssessmentYear – Age
- Derive missing YearBuilt values from nearest neighbor.

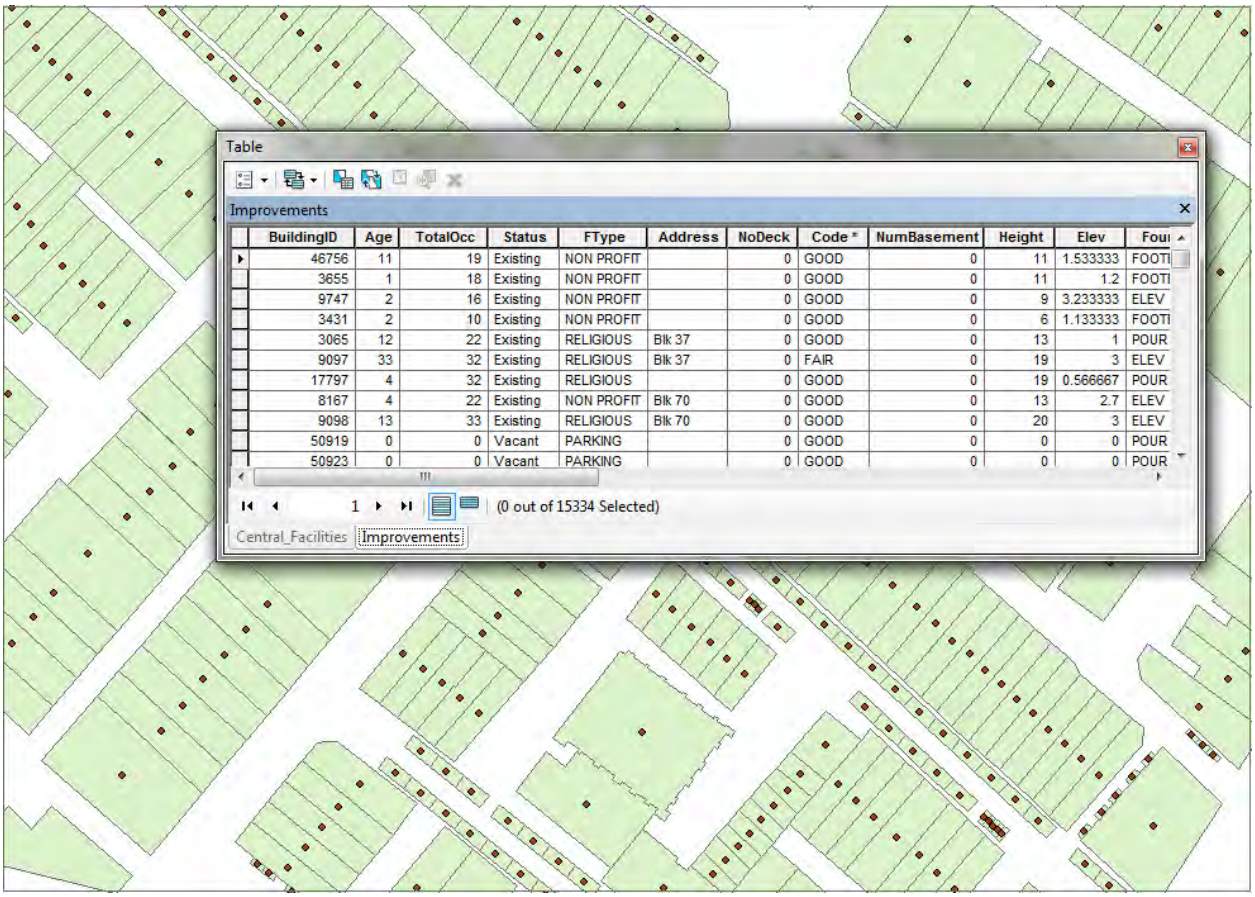


Table
Improvements
BuildingID Age TotalOcc Status FType Address NoDeck Code * NumBasement Height Elev Fou
46756 11 19 Existing NON PROFIT 0 GOOD 0 11 1.533333 FOOTI
3655 1 18 Existing NON PROFIT 0 GOOD 0 11 1.2 FOOTI
9747 2 16 Existing NON PROFIT 0 GOOD 0 9 3.233333 ELEV
3431 2 10 Existing NON PROFIT 0 GOOD 0 6 1.133333 FOOTI
3065 12 22 Existing RELIGIOUS Blk 37 0 GOOD 0 13 1 POUR
9097 33 32 Existing RELIGIOUS Blk 37 0 FAIR 0 19 3 ELEV
17797 4 32 Existing RELIGIOUS 0 GOOD 0 19 0.566667 POUR
8167 4 22 Existing NON PROFIT Blk 70 0 GOOD 0 13 2.7 ELEV
9098 13 33 Existing RELIGIOUS Blk 70 0 GOOD 0 20 3 ELEV
50919 0 0 Vacant PARKING 0 GOOD 0 0 0 POUR
50923 0 0 Vacant PARKING 0 GOOD 0 0 0 POUR
1
(0 out of 15334 Selected)
Central_Facilities
Improvements

TASK 3.2 - MIGRATE BUILDING INVENTORY

The Improvements generated from CBD_Buildings will be used to create Building Inventory.

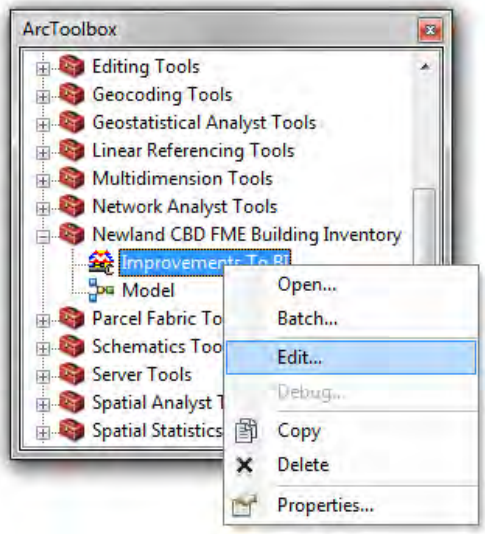
Building Inventory becomes the foundational feature class for updating the Hazus General Building Stock (aggregated data) and Hazus User Defined Facilities (individual points). Where Improvements are unique to Newland (content and structure), Building Inventory is generic (consistent content and structure between projects).

Field mappings and data loading algorithms built into the Improvements tools are provided in Appendix 3.

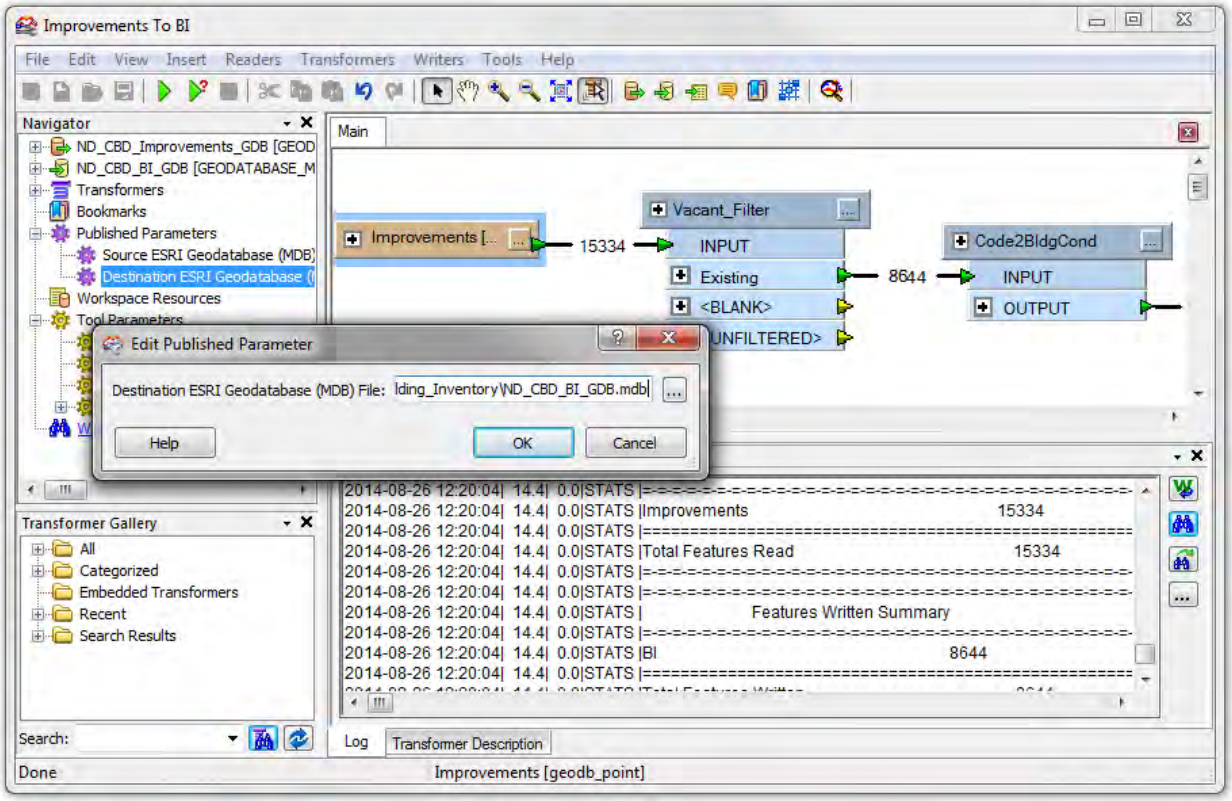
TASK 3.2.1 - CREATE BUILDING INVENTORY FROM IMPROVEMENTS

Tools have been written to convert CBD Improvements into Building Inventory.

- Add the Newland CBD FME BI toolbox to ArcTools from:
  …\Models\CBD\Tools\ND_CBD_FME_BI.tbx
- Right-click | Edit the Improvements_To_BI tool to open up the FME workbench.



- Set the input Published Parameters | Source to:
  …\Models\CBD\Analysis\Inventory\Improvements\
  ND_CBD_Improvements_GDB.mdb
- Set the output Published Parameters | Destination to:
  …\Models\CBD\Analysis\Inventory\Building_Inventory\
  ND_CBD_BI_GDB.mdb



- Run the script and review the log file to make sure that CBD_Buildings records were processed correctly.
- Add CBD Improvements to the MXD and review the results.
- If all OK, save the log file to
  …\Models\CBD\Reports\Logs\
  ND_CBD_FME_Improvements_To_BI_<yymmdd>.txt
- Exit the FME workbench and save the changes to the ND_CBD_Improvements_To_BI tool.

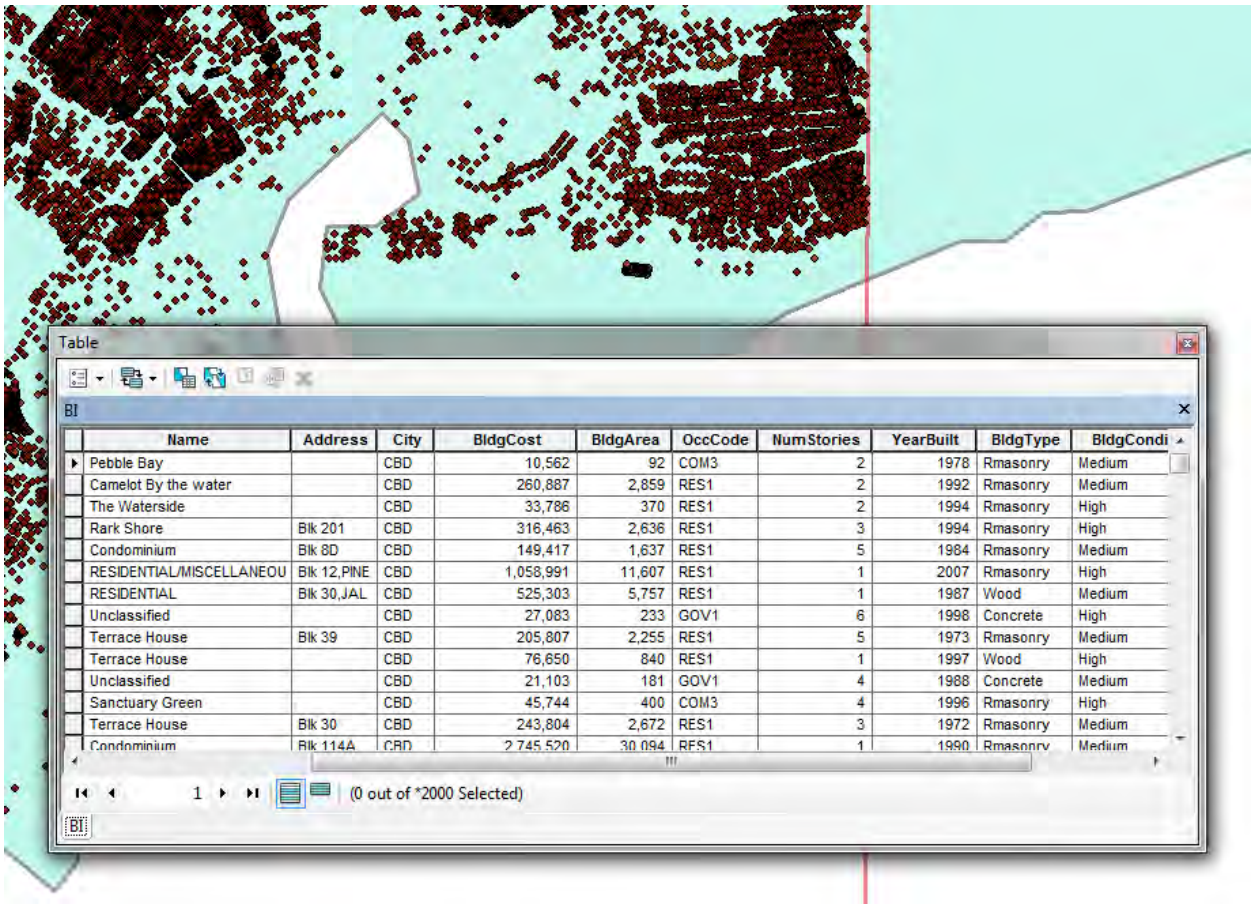
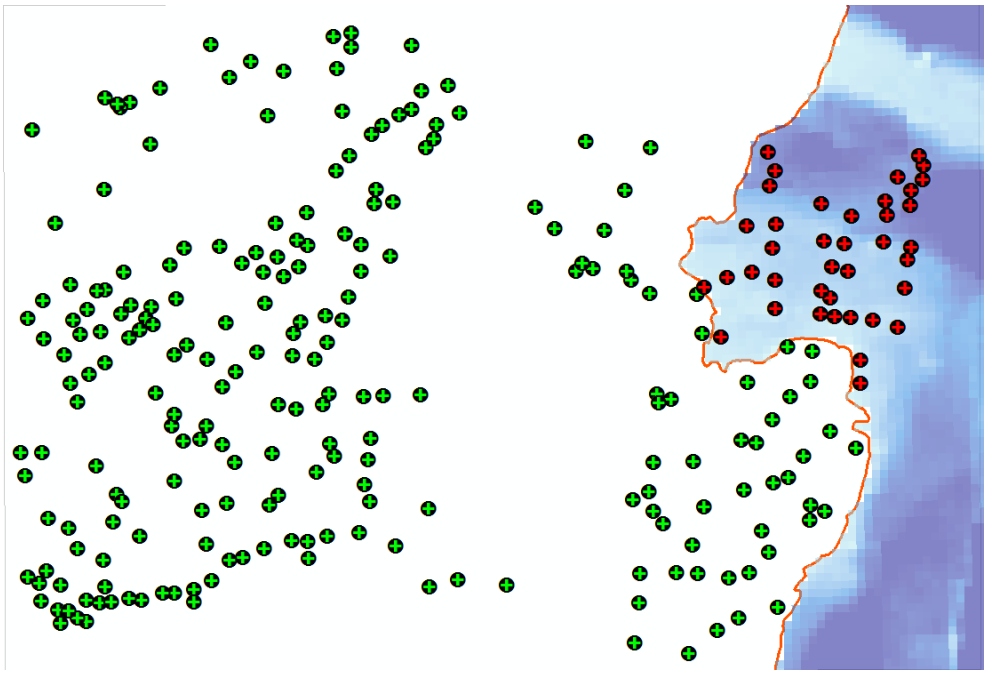


Table
BI
Name Address City BldgCost BldgArea OccCode NumStories YearBuilt BldgType BldgCondi
Pebble Bay 10,562 92 COM3 2 1978 Rmasonry Medium
Camelot By the water 260,887 2,859 RES1 2 1992 Rmasonry Medium
The Waterside 33,786 370 RES1 2 1994 Rmasonry High
Rark Shore Blk 201 316,463 2,636 RES1 3 1994 Rmasonry High
Condominium Blk 8D 149,417 1,637 RES1 5 1984 Rmasonry Medium
RESIDENTIAL/MISCELLANEOU Blk 12,PINE 1,058,991 11,607 RES1 1 2007 Rmasonry High
RESIDENTIAL Blk 30,JAL 525,303 5,757 RES1 1 1987 Wood Medium
Unclassified 27,083 233 GOV1 6 1998 Concrete High
Terrace House Blk 39 205,807 2,255 RES1 5 1973 Rmasonry Medium
Terrace House 76,650 840 RES1 1 1997 Wood High
Unclassified 21,103 181 GOV1 4 1988 Concrete Medium
Sanctuary Green 45,744 400 COM3 4 1996 Rmasonry High
Terrace House Blk 30 243,804 2,672 RES1 3 1972 Rmasonry Medium
(0 out of *2000 Selected)

TASK 3.2.2 – BUILDING INVENTORY REPORTS

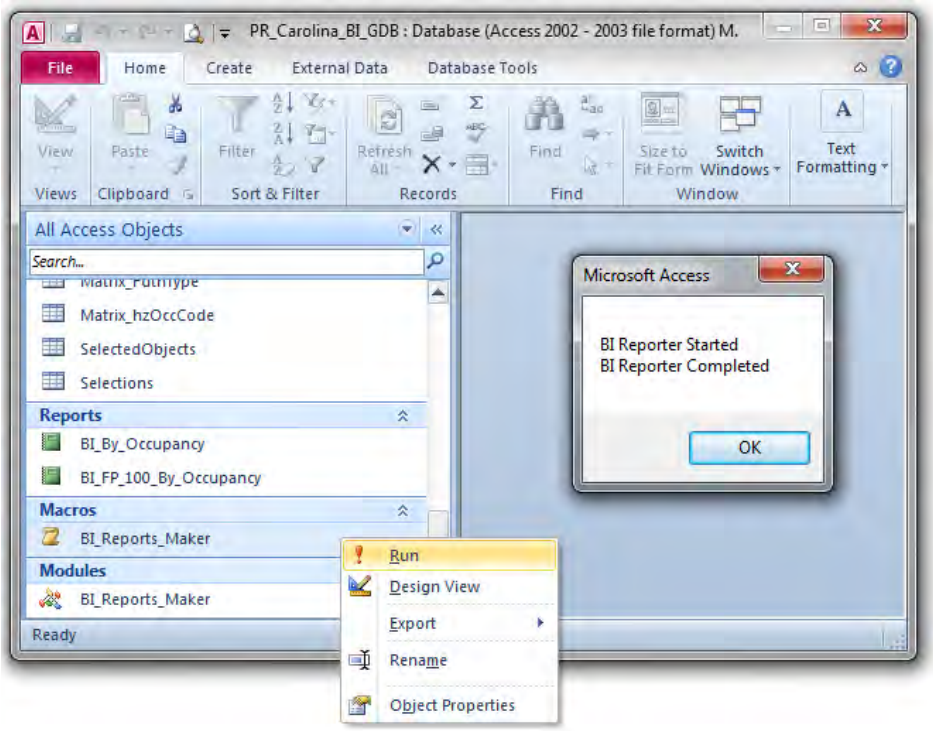
- Add Data for datasets
  - …\Data_Management\Models\CBD\Analysis\Bldg_Inventory\BI\
    - IN_CBD_BI_GDB.mdb | BI
  - …\Data_Management\Models\CBD\Analysis\Flood\Hazus
    - IN_CBD_FL_Analysis_GDB.mdb
      - DFirm_100
- ArcTools | Analysis Tools | Overlay| Clip to determine the flood prone buildings. Save the output feature to:
  - …\Data_Management\Models\CBD\Analysis\Inventory\BI
    - IN_CBD_BI_GDB.mdb
      - BI_FP_100



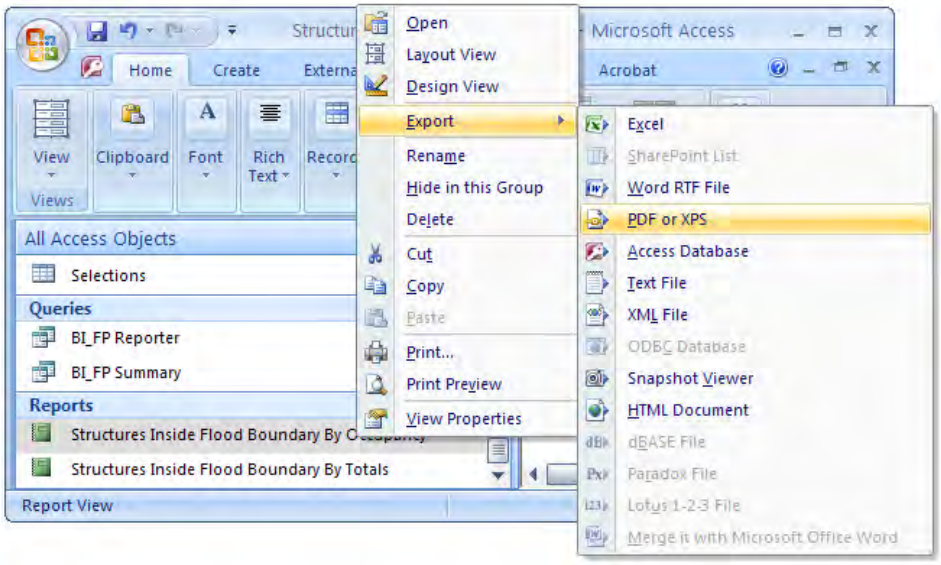
- Close ArcMap

Access scripts have been written to report the structures by general occupancy. Reports may be created for all BI within CBD, or just the BI within the flood boundary.

- Open the Building Inventory database in Access
  …\Models\CBD\Analysis\Inventory\Building_Inventory\
  IN_CBD_BI_GDB.mdb
- Right-Click | Run the macro named BI_Reports_Maker



- Export the report named BI_By_Occupancy to:
  …\CBD\Hazus_Updates\Tables\
  ND_CBD_BI_By_Occupancy.pdf



- Export the report named BI_FP_100_Occupancy to:
  …\CBD\Hazus_Updates\Tables\
  ND_CBD_BI_FP_100_By_Occupancy.pdf

Exposure Inside 1% Chance Flood Boundary Carolina, Puerto Rico

11-Mar-14
1:08:10 PM

Occupancy	Building Area	Building Replacement Cost	Building Count	Average Bldg Area	Average Bldg Cost
Commercial	5,223,920	$376,153,868	884	5,909	$425,513
Education	1,124,316	$80,954,290	98	11,473	$826,064
Government	2,097,575	$151,043,512	501	4,187	$301,484
Industrial	5,554,645	$399,941,460	229	24,256	$1,746,469
Religious	4,797	$345,409	1	4,797	$345,409
Residential	30,941,875	$2,830,771,667	11,585	2,671	$244,348
	44,947,128	**$3,839,210,206**	**13,298**	**3,380**	**$288,706**

TASK 4 – UPDATE HAZUS INVENTORY

Hazus-2.1 comes bundled with default modeling data. The Hazus default data is segregated into geodatabase tables for each State. The Statewide data is the master from which Hazus Study Regions are extracted. Hazus performs natural disaster analysis against the Study Region.

Tools and workflows were developed to update Hazus databases for the HIPOC. The tools and workflows may be applied to Regions outside of CBD, but they will need to be customized to the local data sources.

Task 4 provides the steps needed to import Building Inventory into Hazus as User Defined Facilities. This inventory is generally used for point based (detail) flood loss analysis.

Task 4 – Import User Defined Facilities

Use the FME script called BI_To_UDF to create User Defined Facilities
Create a Hazus Flood Study Region
Import UDFs into the Hazus Study Region and test the results

TASK 4.1 – CREATE USER DEFINED FACILITIES

The Building Inventory will be imported into the Hazus Study Region as User Defined Facilities for point analysis of detailed geographic areas. Each UDF point represents a BI point at risk to earthquake, flood or wind losses.

User Defined Facilities are not supported in CDMS. User Defined Facilities will be imported into the Study Region using Hazus. The UDFs must be re-imported to each Study Region to analyze losses to individual structures (typically flood models or other small/detailed geographies).

Buildings with potential losses from flood hazards will be translated to User Defined Facilities. BI is a feature class, from which Access UDF tables formatted for Hazus flood modeling will be created. Only UDFs within the flood boundary will be imported (Task 3).

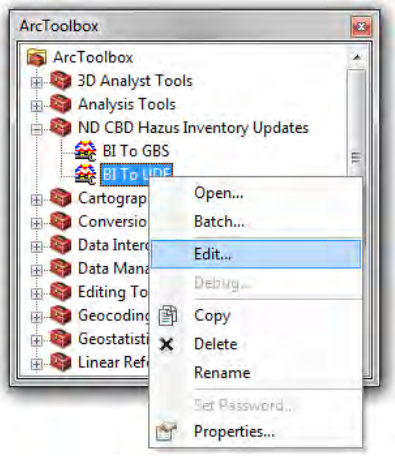
[Note] The steps to import the User Defined Facilities into a Study Region using Hazus Import tools are documented in the Hazus Flood User Manual.

[Note] The tools also support earthquake models. To import UDFs into an earthquake model, use the existing workflow and change the hazard type from Flood to Earthquake.

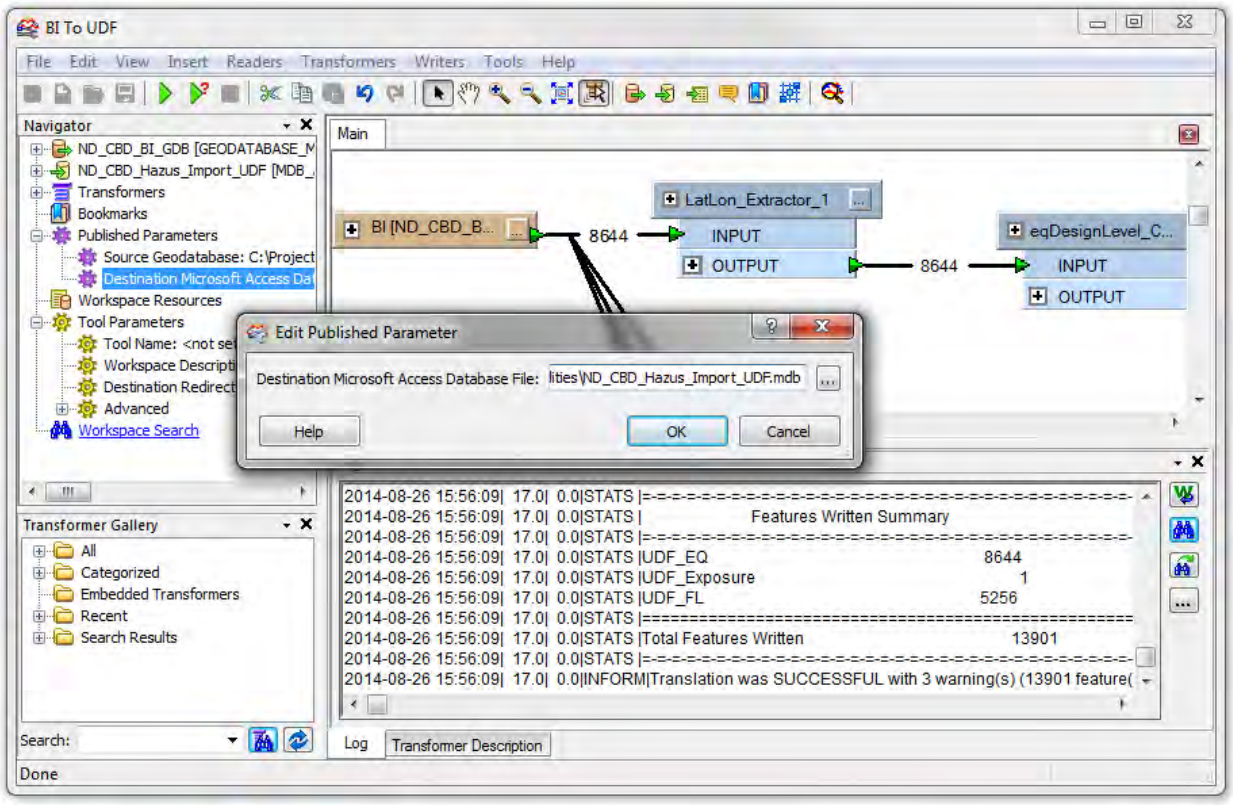
TASK 4.1.1 - CREATE UDFS FROM BUILDING INVENTORY

A FME script named BI_2_UDF migrates Building Inventory to UDFs. Building Inventory is re-processed to fit the Hazus database structure and domains. The script is setup for CBD, but may be modified for other Regions.

- Open ND_CBD_Hazus_Updates.mxd
- If needed, add the HIPOC Newland FME toolbox to ArcTools from:
  …\Models\CBD\Tools\ND_CBD_FME_Hazus_Updates.tbx
- Right-Click | Edit the BI To UDF tool



- Set the input Parameters Source to:
  …\Models\CBD\Analysis\Inventory\Building_Inventory\
  ND_CBD_BI_GDB.mdb | BI_FP_100
- Set the output Parameters Sources to:
  …\Models\CBD\Hazus_Updates\User_Defined_Facilities\
  ND_CBD_Hazus_Import_UDF.mdb



- Run the script and review the log file to make sure all records were processed. All BI_FP_100 records should be migrated as UDFs.
- Save the log file to
  …\Models\CBD\Reports\Logs\
  ND_CBD_BI_To_UDF_FL_<yymmdd>.txt

- Save the changes to the FME script and exit ArcGIS.

The populated Access UDF tables can now be imported into Hazus.

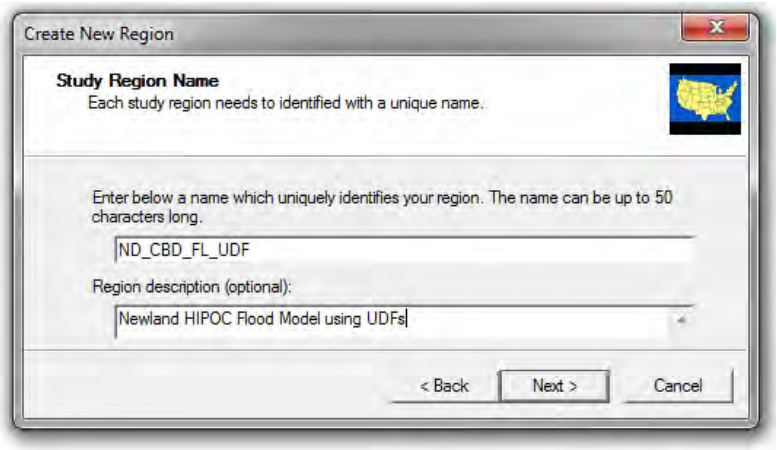
The algorithms used in the BI_2_UDF FME script are provided in Appendix 5.

TASK 4.2 – CREATE STUDY REGION

TASK 4.2.1 - CREATE A STUDY REGION

A Study Region must exist before User Defined Facilities can be imported. Steps to create a Study Region and perform flood modeling are documented in the CBD Risk Assessment Workflow.

- Open Hazus
- Create a Flood Study Region for CBD, Newland.
  Name: ND_CBD_FL_UDF
  Description: HIPOC Flood analysis using updated GBS and UDF

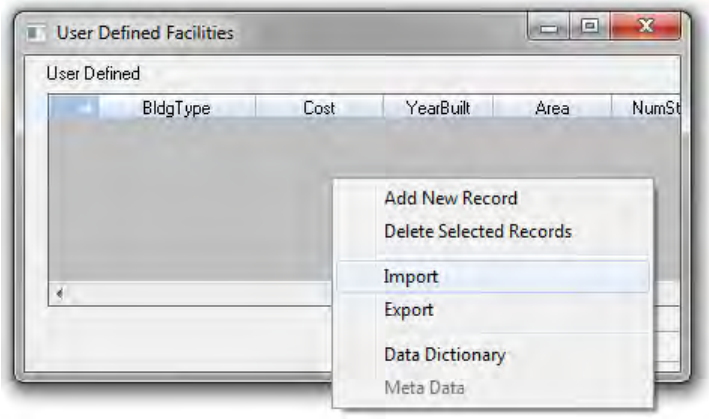

Create New Region
Study Region Name
Each study region needs to identified with a unique name.
Enter below a name which uniquely identifies your region. The name can be up to 50 characters long.
ND_CBD_FL_UDF
Region description (optional):
Newland HIPOC Flood Model using UDFs
< Back
Next >
Cancel

TASK 4.3 – IMPORT USER DEFINED FACILITIES

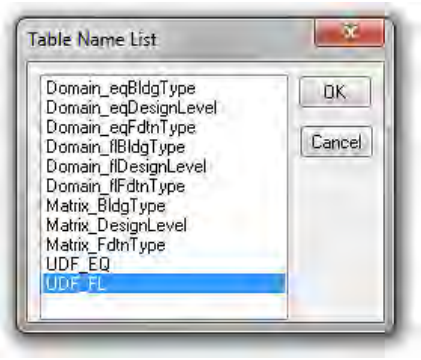
TASK 4.3.1 IMPORT UDFS TO HAZUS

[Note] Steps to import UDFs into Hazus are documented in more detail in the Hazus Flood User Manual.

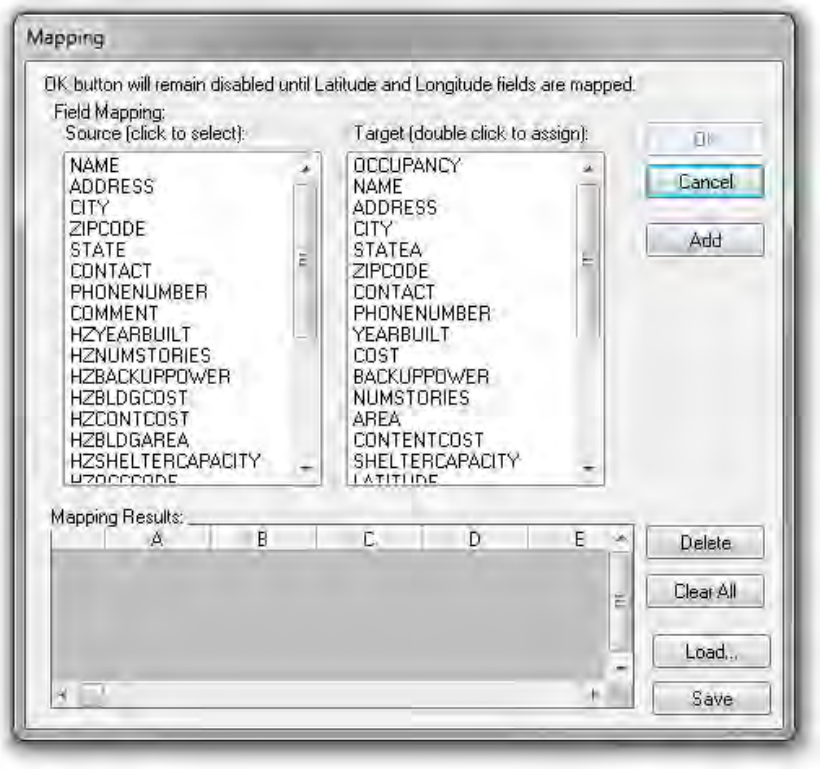
- Open Hazus
- Open the Flood Study Region
  ND_CBD_FL_UDF
- Inventory | User Defined Facilities
- Right-click in the open area of the User Defined Facilities window and select **Import**



- Select the CBD UDF database
  …\Data_Management\Models\CBD\Hazus_Updates\User_Defined_Facilities\
  ND_CBD_Hazus_Import_UDF.mdb
- Select the table UDF_FL from the Table List and click **OK**



- In the Mapping window select the **Load** button and navigate to:
  …\Data_Management\Models\CBD\Hazus_Updates\Tools\
  UDF_FL.sav

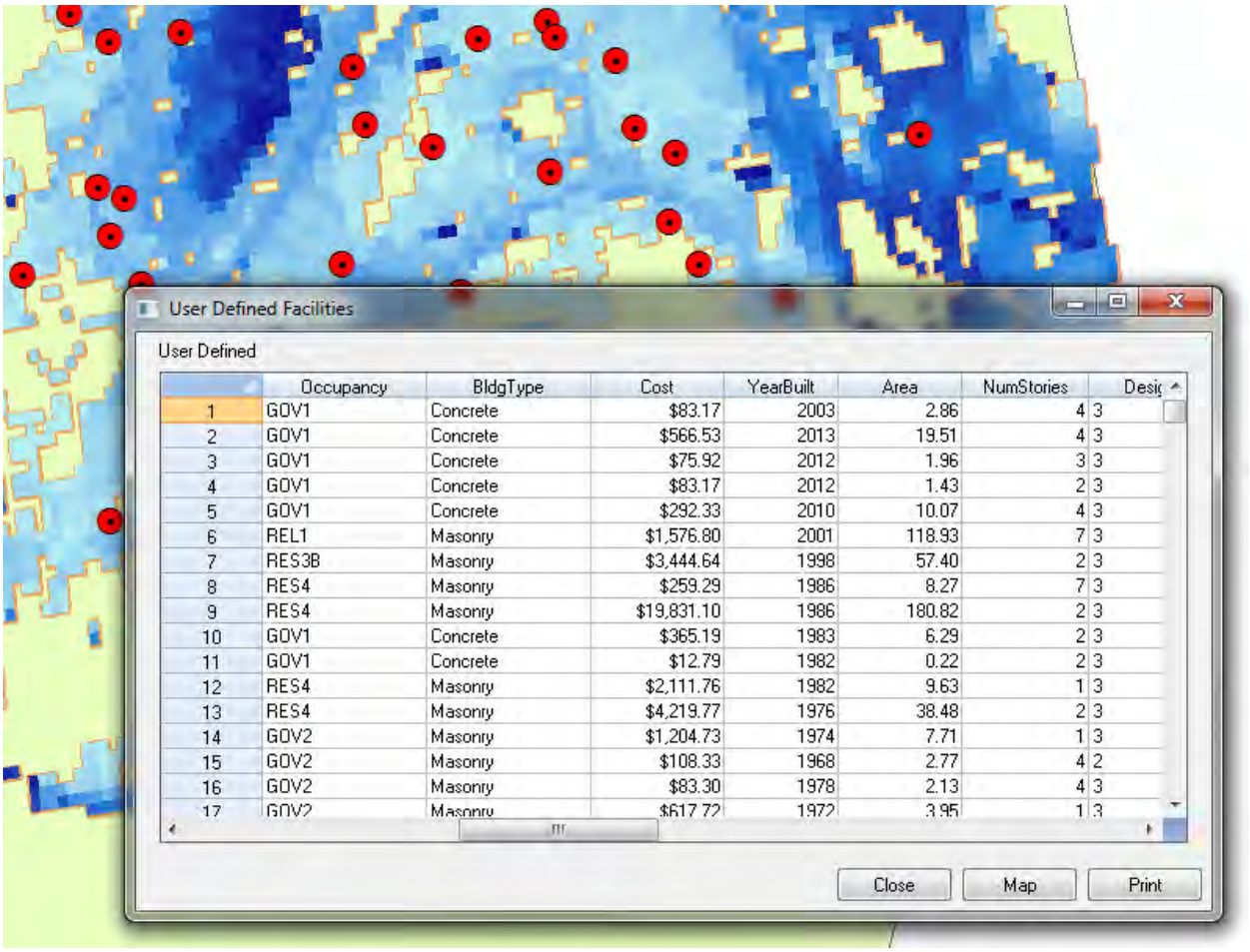


- Choose **OK** to finish importing User Defined Facilities into the Study Region inventory.

TASK 4.3.2 - REVIEW UDFS IN HAZUS

Review the UDFs in Hazus before proceeding:

- Inventory | User Defined Facilities
- Click on Map to display the UDFs



Make sure that the UDFs are correctly loaded into the Study Region.

- The UDF count should match the flood prone BI count.
- UDFs should not be outside the County/study region boundaries.
- The UDF locations should be the same as the BI locations.
- The attributes populated in:
  …\Models\CBD\Hazus_Updates\User_Defined_Facilities\
  ND_CBD_Hazus_Import_UDF.mdb
  UDF_FL_100
  should be viewable in Hazus | Inventory | User Defined Facilities
- Foundation Type values should be numbers (4,5 and 7 are the most common values), not letters (B, C and S).

TASK 5 HAZUS FLOOD ANALYSIS

Losses are reported from the User Defined Facilities that have been generated from the Building Inventory. Hazus provides several options for performing flood analysis based upon the available source materials. The HIPOC process to perform flood analysis requires a pre-defined flood depth grid (Option 4).

Option	Analysis	Conditions for Use
1	H&H SRP	Hazus generates flood boundaries and flood depth grid from the DEM. Single return periods (usually 100-year) are used.
2	H&H FIS	Hazus generates flood boundaries and flood depth grid from the DEM. Return periods are enhanced using FIS discharge values.
3	EQL	Hazus generates the flood depth grid from the DEM and provided flood boundary.
4	FDG	Hazus models the losses from a user-defined flood depth grid that has been generated from another modeling application (such as HecRas).

[Note] Option 4 is documented. Consult the Hazus Flood User's Manual for Options 1-3 using alternative data sources.

TASK 5.1 IMPORT FLOOD DEPTH GRID

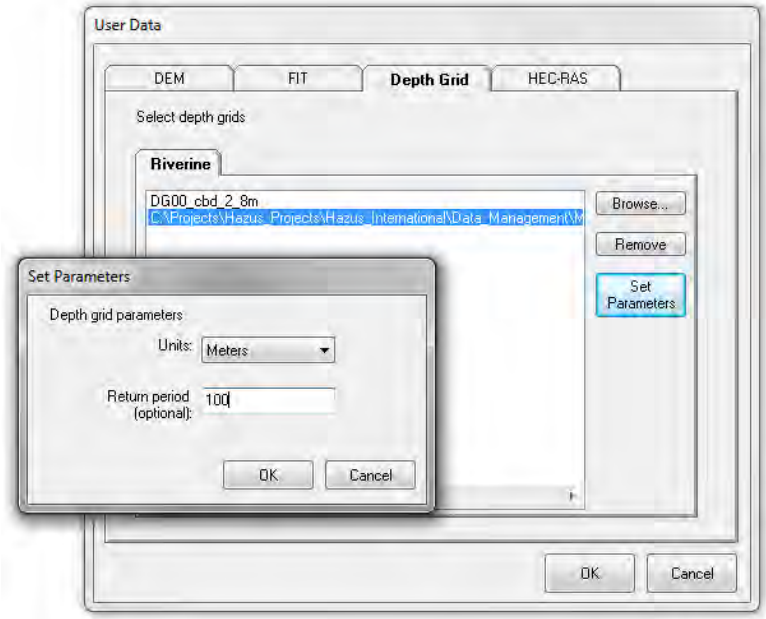
Option 4 is the preferred option when third-party flood depth grids are available.

1. Hazard | User Data | Depth Grid to import the FDG
2. Hazard | Scenario | New
3. Hazard | Riverine | Delineate Floodplain
4. Analysis | Run
5. Results | User Defined facilities

TASK 5.1.1 – PREPARE FLOOD DEPTH GRID

The flood depth grid to be used is specified in the User Data area. A relationship is built between the flood depth grid and the flood scenario.

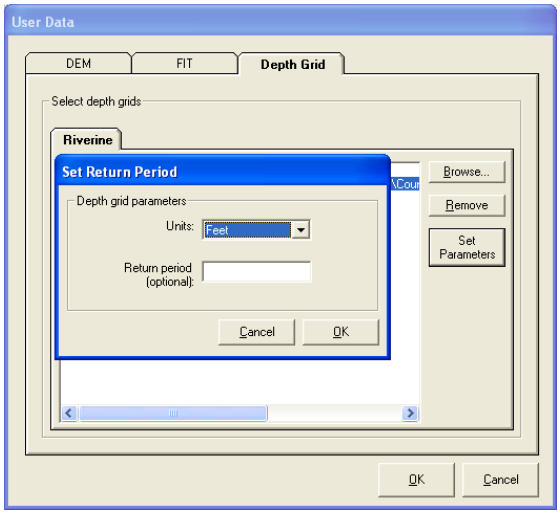
- Hazard | User Data
- Select the Depth Grid tab
- Use the Browse button and navigate to:
  …\Data_Management\Data_Sources\Newland\Hazards\
  cbd_2_8m
- Set the Parameters for Flood Depth grid
  Units to "Meters"
  Return Period to "100"



TASK 5.2 CREATE FLOOD SCENARIO

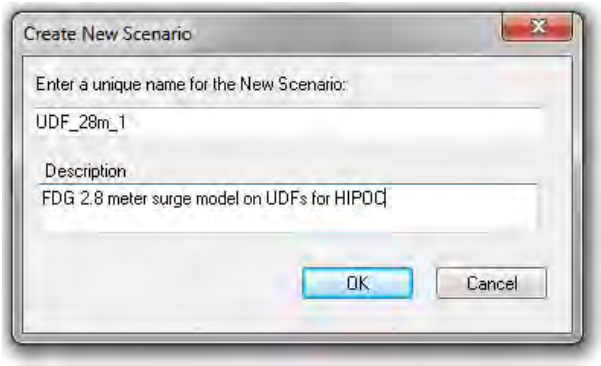
TASK 5.2.1 – CREATE SCENARIO

- Go to User Data to add the flood depth grid:
  C:\HazusRegions_MR4\<Study Region>\Quick\quickdepth
- Set Parameters:
  Units = "Feet"
  Return Period (Optional) ="100"

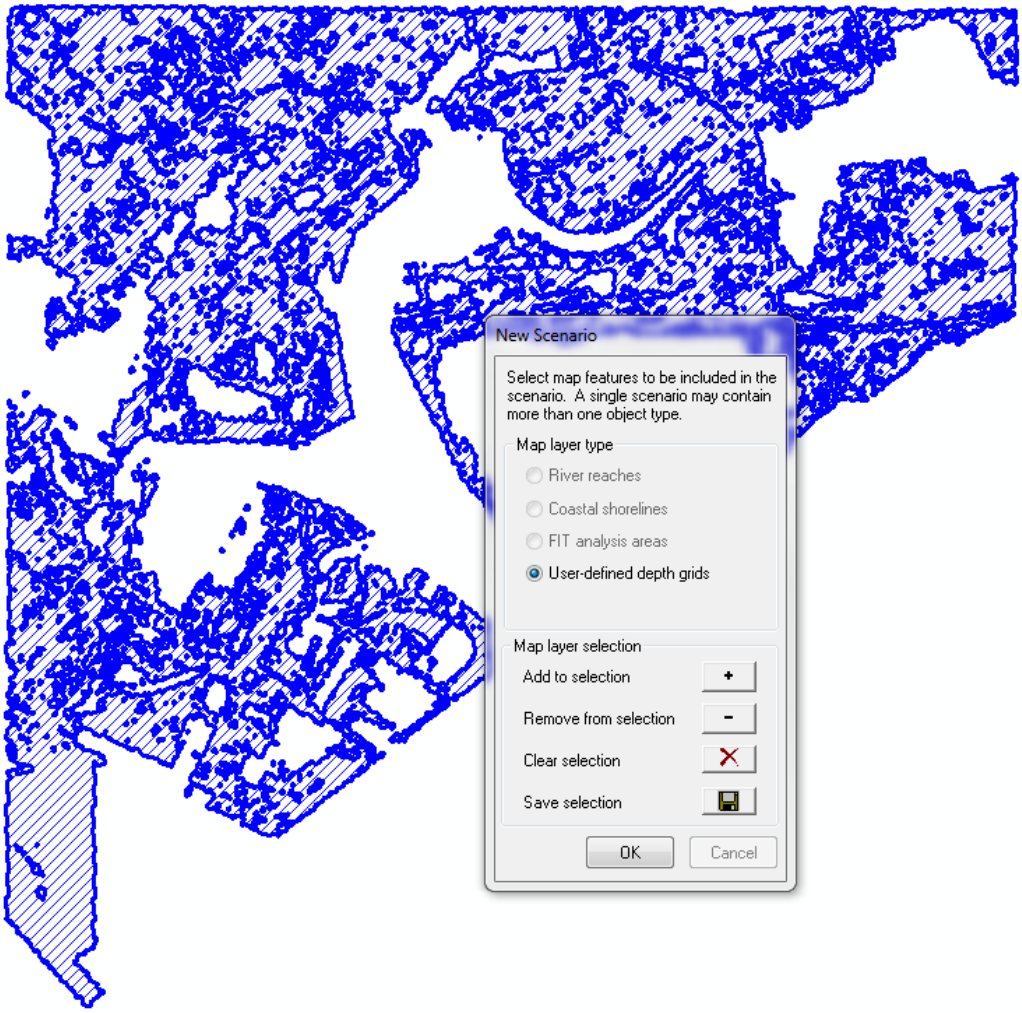


- Hazard | Scenario | New. Name the new Scenario based upon the method used to set up the model.
  <Inventory>_<Period>_<ID>
  where
  <Inventory> = "GBS" Aggregate General Building Stock
  "UDF" User Defined Facilities

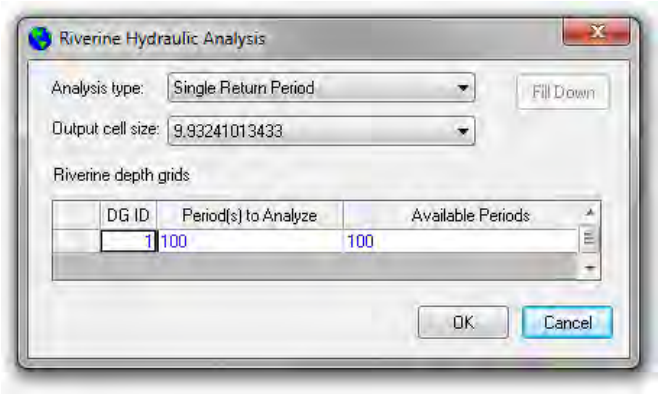
<Period>	"SRP100"	100yr single return period
	"28m"	2.8 meter surge
<ID>	"1"	Unique Study Case Number (1-9)



- Select the Flood Depth Grid
  In the New Scenario window use the "Add to Selection" button to drag a box around the desired flood depth grid.
  Save the Selection and click OK to complete the Scenario set up.



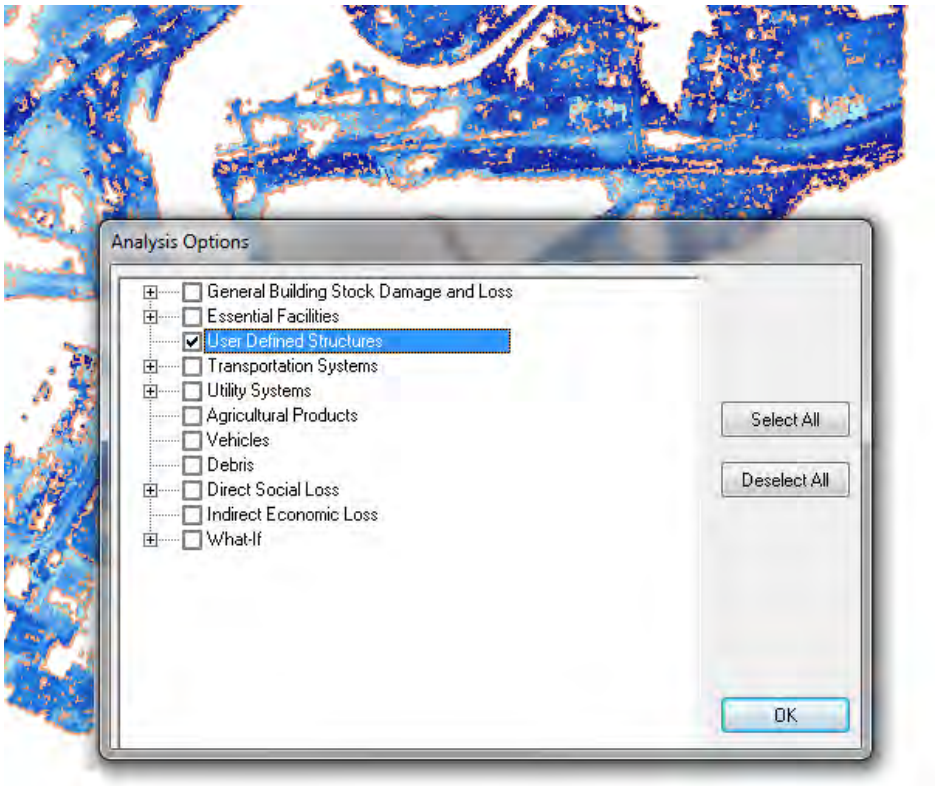
- Hazard | Riverine | Delineate Floodplain
  Set the Analysis type to “Single Return Period”
  The Period to Analyze should state “100”
  Click OK



TASK 5.3 RUN FLOOD ANALYSIS

TASK 5.3.1 RUN ANALYSIS

- Analysis | Run
- Select User Defined Facilities in the Analysis Options Window

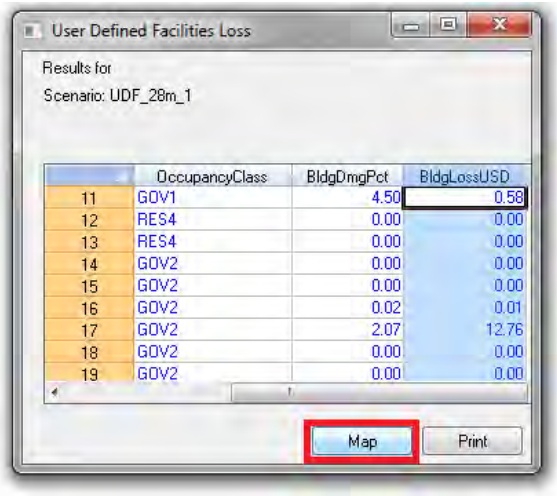


TASK 5.4 EXPORT RESULTS

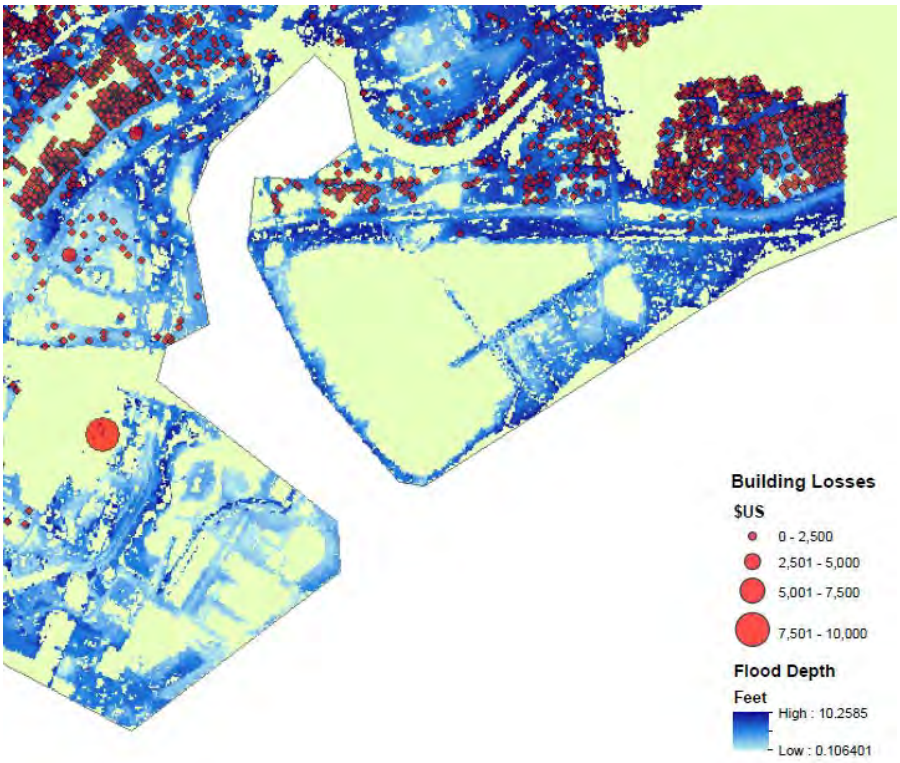
TASK 5.4.1 EXPORT MAPS

UDF analysis results are unavailable in the Hazus Global Summary Report. Instead, UDF losses are exported to a GDB and reported outside of Hazus.

- Hazard | Study Case | Open
  UDF_28m_1
- Export the flood boundaries to:
  ...\Models\ND\Analysis\Flood\Data\
  ND_CBD_FL_Analysis_GDB.mdb
  FL_Bndry_100
- Results | User Defined Facility
- Select the BldgLossUSD column and click Map



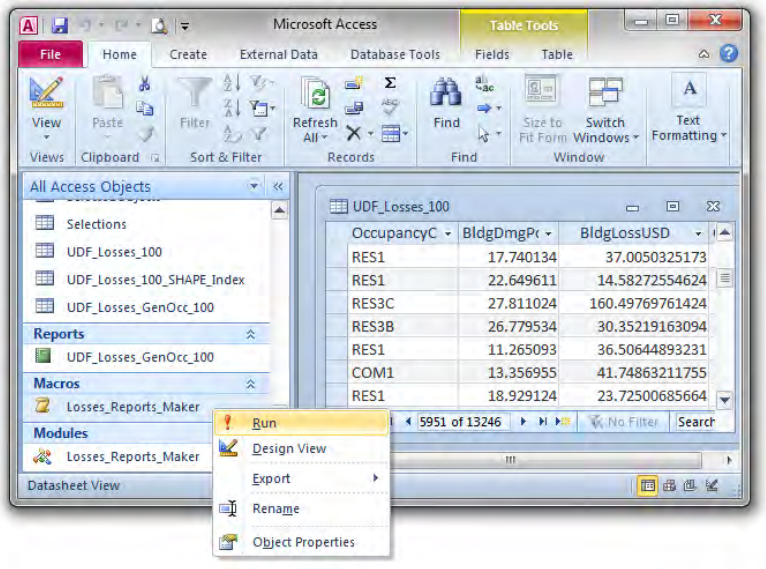
- Right-click the UserDefinedFlty feature class and Export to
  ...\Models\ND\Analysis\Flood\Data\
  ND_CBD_FL_Analysis_GDB.mdb
  UDF_Losses_100
- Export the Hazus map as a PDF:
  ...\Models\ND\Analysis\Flood\Maps\
  ND_CBD_UDF_Losses_100.pdf
- Exit Hazus



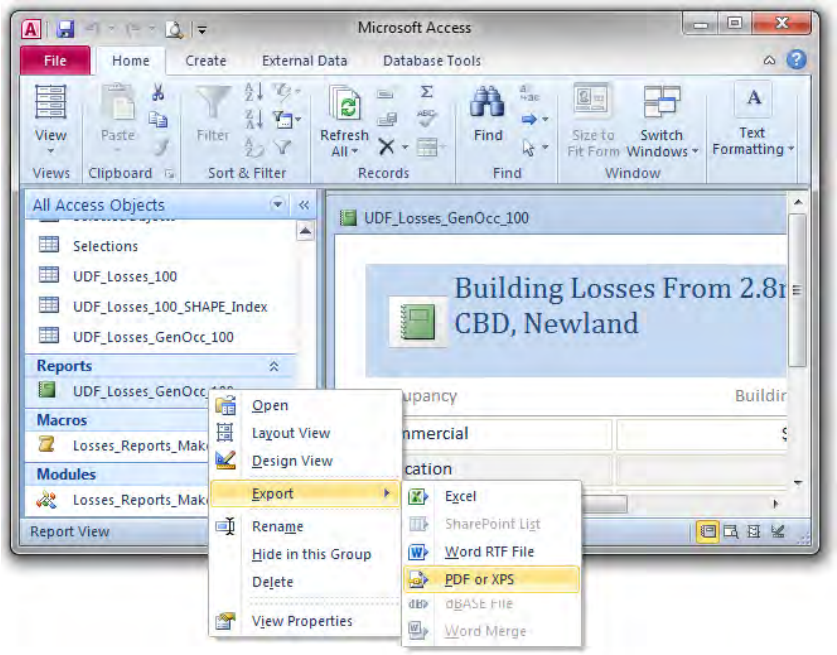
TASK 5.4.2 EXPORT TABLES

The UDF loss reports will be created in Access

- Open Access to:
  ...\Models\ND\Analysis\Flood\Data\
  ND_CBD_FL_Analysis_GDB.mdb
- Run the macro named Losses_Reports_Maker



- Run the macro named Losses_Reports_Maker



- Export the UDF_Losses_GenOcc_100 report as a PDF:
  ...\Models\ND\Analysis\Flood\Tables\
  ND_CBD_UDF_Losses_GenOcc_100.pdf

Building Losses From 2.8m Sea Rise
Central Business District, Newland

Occupancy	Building Losses	Buildings Damaged
Commercial	$87,901	854
Education	$4,334	76
Government	$15,003	348
Industrial	$43,977	211
Religious	$38	1
Residential	$435,895	7,722
	$587,148	**9,212**

TASK 5.4.3 BACKUP STUDY REGION

Backup the Study Region into a compressed HPR.

- Open Hazus GUI
- Export Region to
  ...\Models\ND\HPR\
  ND_CBD_FL_UDF.hpr

Appendix 1 Glossary

The following terms and abbreviations are used throughout the workflow documentation.

Abbreviation	Context	Definition
CDMS	Abbreviation	Comprehensive Data Management System
D3	Abbreviation	Data 3.0 Professional Services
EF	Abbreviation	Essential Facilities
GBS	Abbreviation	General Building Stock
HIPOC	Abbreviation	Hazus International Proof of Concept
UDF	Abbreviation	User Defined Facilities
BI	Feature Class	Building Inventory
FI	Feature Class	Facility Inventory
DEM	Raster	Digital Elevation Model 10m statewide
Building Inventory	Term	Editing point GDB for Hazus GBS or UDF analysis
Essential Facilities	Term	Hazus Care, Fire, EOC, Police, School facilities
Facility Inventory	Term	Editing point GDB for Hazus EF or CF analysis
General Building Stock	Term	Hazus aggregate inventory by Tract or Block
Study Region	Term	Hazus modeling extent (a state)
Study Area	Term	Hazus area extent (a country)
User Defined Facilities	Term	Hazus point inventory
CBD	Term	Dummy Study Region (subset of Newland)
Newland	Term	Dummy country (equivalent to a Hazus state)

Appendix 2 Issues and Questions

Modeling issues were discovered during HIPOC Ver 2.2. Some have been fixed, but others need consideration before proceeding to the next country.

HAZARDS

- Flood boundaries and/or depth grids may not be available for other counties.

ENVIRONMENT

- Do we need to consider SQL Server Management Studio? Scripts are provided to compress the Study Regions without needing SQL Server.
- Hazus 2.1 SP3 (released on 20-Feb-2012) was used to develop the HIPOC Ver 2.2 workflow. The tools may need to be re-run on the current release.

WORKFLOW

- Sometimes we "inherit" attributes from surrounding BI (e.g. Year Built). This was not done in HIPOC.
- SQL Server Management Studio is a better option for reporting. Currently the workflow is based upon Access ODBC connections to SQL Server, which assumes that SQL Server Management Studio is unavailable.
- The xFactors ($/sqft) are derived from Newland. We need to determine new xFactors for each country. The Newland xFactors were based upon market value, not replacement cost.

REPORTING

- Hazus UDF reporting options are weak. HIPOC Ver 2.3 will explore GBS inventory to unleash better reporting tools (debris, shelter, business interruption losses etc…)

HAZUS

- Compress the Study Regions – the SQL log files are huge.
- HIPOC Ver 2.3 will explore the idea of syHazus.mdb changes to use the existing country abbreviations (e.g. 'SG' for Singapore) rather than existing state abbreviations (e.g. 'ND' for North Dakota).

Appendix 3 Hazus Hints

INSTALLATION

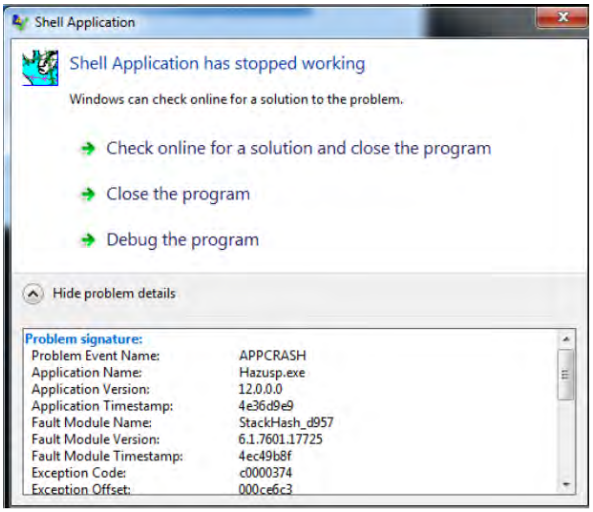
Installing Hazus software in the US is a tricky proposition. Preparing a working Hazus environment on a non-US machine will take some effort.

Here are some generic things to be mindful of:

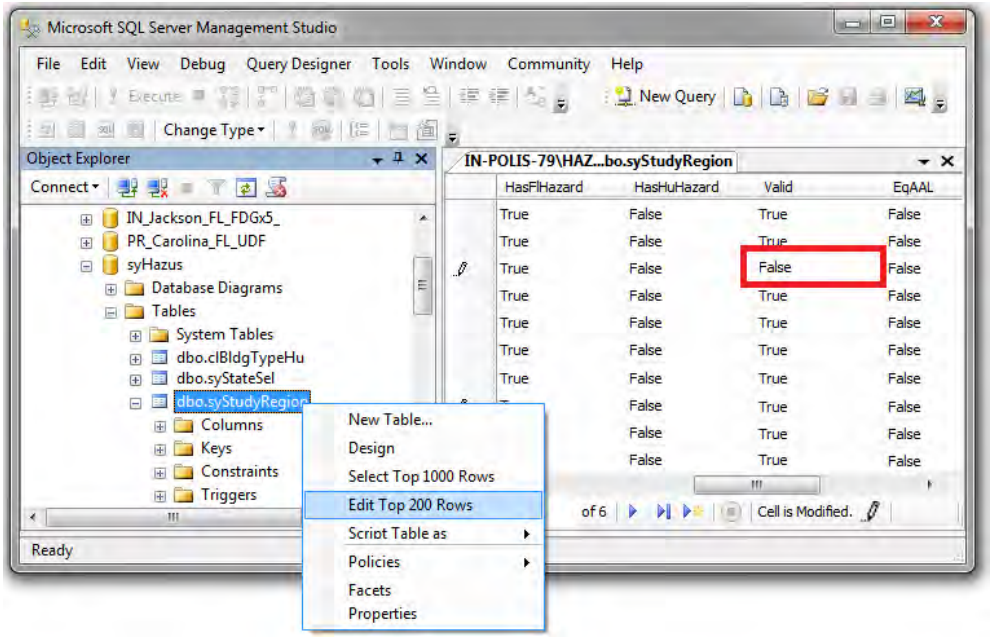
- You MUST have full admin privileges to install Hazus and its service packs. This is the most common problem.
- The PC must be configured for Hazus 2.1. This means, same operating system (no upgrades, service packs) and same version of ArcGIS (no upgrades, service packs).
  Hazus SP1, SP2 and SP3 may support newer upgrades, but check the install notes just to be sure.
- Make sure all ArcGIS extensions have Hazus-certified service packs. In particular, Data Interoperability Extension must be FME 2010 SP2.
- Hazus installation is a 'one-time' shot. In other words, if SP2 does not install properly (say because someone before you hit "Yes" and did not have the required permissions), then your install is toast. There is no "uninstall SP2" option. You cannot back out. Hazus must be uninstalled, re-installed, and then SP1, SP2 etc….
- Run Hazus service packs in sequence (i.e. assume that SP2 requires SP1). Hazus is not consistent about this – sometimes service packs include previous packs, other times not. Do not take the chance of missing a service pack (i.e. SP3 installed, but not SP1).
- The CDMS error "Microsoft Jet OLEDB 4.0 provider is not registered" is not related to Hazus SP1 or SP2.
- The solution for most Hazus users is a dedicated Hazus PC. Once setup and working, they are never touched. PCs are upgraded between projects (never during a project).
- If you can't have a dedicated Hazus PC, then you can setup a dual-boot virtual drive – one for Hazus, and another for everyone else. Boot to VHD (Virtual Hard Drive) is provided with Microsoft Windows. It allows a PC to be partitioned into multiple configurations. The Hazus configuration is a user-selectable option at start-up.

And there are added complications on international PCs:

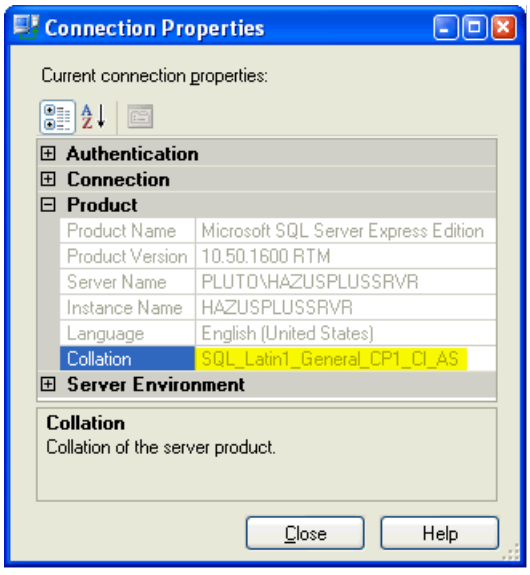
- You may be able to fix Study Regions that crash.


Shell Application
Shell Application has stopped working
Windows can check online for a solution to the problem.
Check online for a solution and close the program
Close the program
Debug the program
Hide problem details
Problem signature:
Problem Event Name: APPCRASH
Application Name: Hazusp.exe
Application Version: 12.0.0.0
Application Timestamp: 4e36d9e9
Fault Module Name: StackHash_d957
Fault Module Version: 6.1.7601.17725
Fault Module Timestamp: 4ec49b8f
Exception Code: c0000374
Exception Offset: 000ce6c3

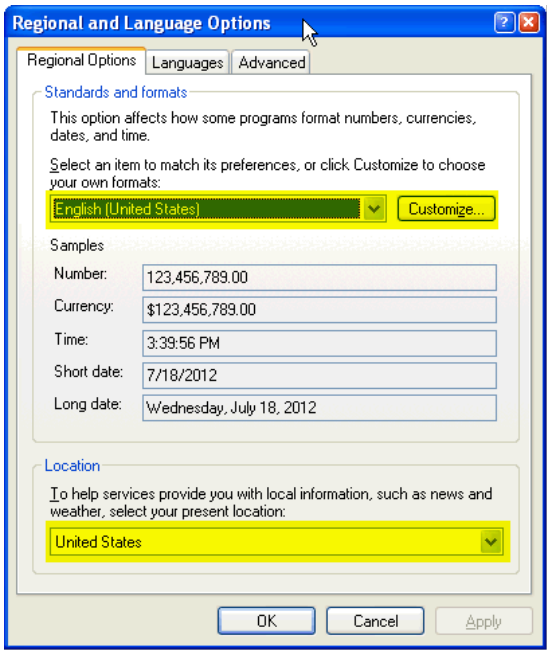
Review the log files first (DTSLOG, FLDTSLOG, AGGREGATIONLOG) in the Study Region folder. If all OK, then check the syHazus.mdf | dbo.syStudyRegion and change



- Do not try to install Hazus on a non US-English version of windows. Short of re-installing Windows (with the US-English code), there are no easy solutions. Errors may come from SQL Server which insists on consistency between the collation sequence used to create the databases (which is US English) and collation sequence of the target OS. [PIO] If we pass the correct collation type (see below) during Hazus install time (when SQL Express is being installed), we may end up with an international version of Hazus. Alternatively, we have a separate SQL Server install (after Hazus has been installed).



- Changing Regional and Language options (highlighted in yellow) may salvage re-installing Windows and Hazus. It's not ideal to force non-US computers to use US keyboard, character set, etc…, but it may work.



ENVIRONMENT

- Compress the Study Region log files frequently. Keep them below 1GB.
  SQL compress scripts have been re-written for SQL 2008/Win7.
- Backup Study Regions frequently. The Hazus processes take too long to risk losing the results. Recommend that
  Duplicate the active Study Region daily.
  Use the convention <Study Region Name>_Verxx
  Work in the most recent Study Region.
  Delete Study Regions more than three versions old.
- SQL Server Management Studio is a must.
  Used to re-establish SQL Server instances. Use Restore Database.
  Used to compress the SQL logs which grow very large. Use Compress Log.
  Used to manage the UDF imports.
  The Hazus process to copy a Study Region corrupted the master Study Region. Not recommended.
  [PIO] SQL Server Management Studio is a better option for reporting. Currently the workflow is based upon Access ODBC connections to SQL Server, which assumes that SQL Server manager is unavailable.
- Hazus fixit tools are a must:
  FixSR runs to re-establish lost Scenarios – this is a lifesaver
  [TBD] FixSRBP does not work in Windows 7 – the Study Region Names do not appear.

FLOOD MODELING

- The DFirm hurricane boundary contains many records (as many as a few thousand). Run Dissolve to merge the 100-year polygons into as few as possible. Retain all donuts. The fewer the polygons, the faster the Hazus processing.
- The ESRI Dissolve routine requires at least 2GB RAM to dissolve the 1000+ polygons within a DFIRM to a single polygon. The Dissolve routine reports the problem, but the only solution is more memory.
- Flood depth grid names are limited to 13 characters. The folder structure cannot be deep – move FDGs to \Temp before importing them into Hazus.

UDF FAQs

The limitations of using aggregate data to model flood losses are known. Increasingly, UDFs are being used to model individual sites. The buildings most at risk are clipped to the flood boundary and imported into Hazus to determine losses. Alternatively, UDFs may be used to model the following feature classes that are not currently supported in Hazus:

State-owned buildings
University campus buildings
Flood prone buildings (all occupancy classes)

The following questions have been submitted to the Hazus Help Desk to plan for future Hazus releases:

- UDF reporting is weak. Results are not included in the Global Summary Report.
- It is not possible to generate annualized losses from UDFs.
- The UDF damage curves can be customized in Hazus 2.1 SP3, but the process is not documented
  BldgDamageFnID
  ContDamageFnID
  InvDamageFnID
- The following fields are not used in the data model:
  Foundation Type (except '4'- Basement)
  Building Type
  Design Level
  Condition
  Area
- If the units for UDF.Cost and UDF.ContentCost are in $1 x 1,000, then the reported losses will be in $1 x 1,000. If the units for UDF.Cost and UDF.ContentCost are in $1s, then the reported losses will be in $1s. The Hazus UDF Losses dialog window has "in thou. dollars" in the title bar, but the exported table headers show USD (so you lose either way).
  The general guidelines are:
  If BldgCost, ContCost and BldgArea values are imported in $1x1,000 then the losses will be reported in $1x1,000

  If BldgCost, ContCost and BldgArea values are imported in $1s then the losses will be reported in $1s

  If it is important that the GBS "match" the UDFs, then import the UDFs in $1 x 1,000. For detailed analysis of buildings, it may be better to leave the units as $1s.

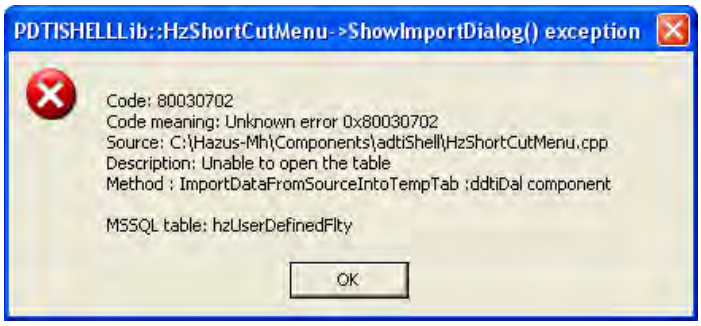
- Values of "0", "" or <Null> do not work, even though they may exist in Hazus. Make sure that the following fields are populated correctly:
  YearBuilt = "1970" (default if "0" or <Null>)
  BldgType = "Wood" (default if <Null>)
- UDFs higher than 8 stories will not pass Flood analysis (they will not run at all, with or without damage functions). This will need to be fixed in Hazus. Can be patched by setting all stories GT 8 to 8. [PIO] Sample inventory up to 3.5m (highest flood risk), and develop damage curves around the statistical sample. There will be two damage curves per specific occupancy - one low range, one high range. Run the model twice to determine the range of risk. In this case, set NumStories to '1' since only the first floor (and below) is of interest.
- Basement square footage is not included in Building Area. Hazus uses total finished area (sqft), so if NumStories = 3 and Area =6,000 then 2,000 per floor. Sometimes we determine Area from building footprint geometry and building height, where Area = building footprint * height / 10 (assumes 10' per floor). Basements are captured in the according to Foundation Type. There is a way to tell Hazus the size of the basement. Very often we have partial basements (i.e. half crawl, half basement), but I still treat these as Basement = 'Y'. If basement areas are provided, use them to set Foundation Type to 'Basement'.

- Unless the user defines specific damage functions, the User Defined analysis uses the GBS damage functions according to Specific Occupancy. From the Flood User Manual:

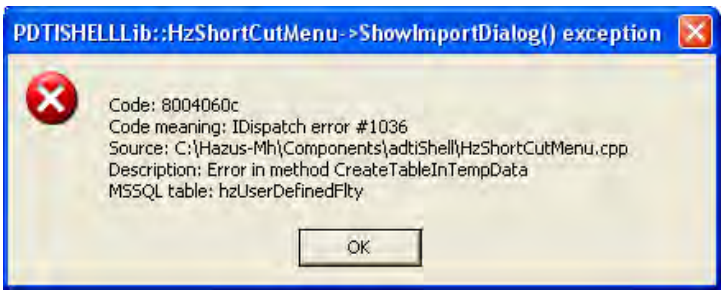
  "The Flood Model will use the damage functions from the General Building Stock damage library. The damage functions are associated by the Occupancy code and key fields, such as "Num of Stories" and "Foundation." For example, RES1 with 2 stories and a basement would be listed under R12B and a COM1 that is mid rise and has no basement would be listed under C1MN."

UDF IMPORTS

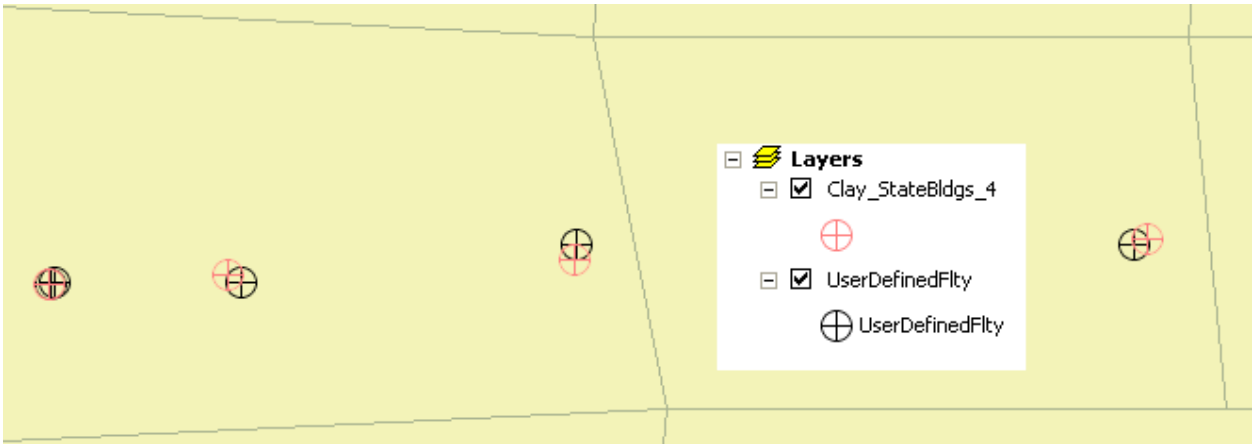
- Before importing the UDFs:
  Copy <Study Region>\UDS.mdb to UDS-Copy.mdb (to backup the spatial GDB)
- Do NOT map UDFs while attempting to import.
- Do not cancel the Import – this is a one-time shot. Re-starting the import tools will result in duplicate records.
- Only one UDF import session is allowed during a Hazus session. The following error message appears if you attempt to import twice. The Hazus application has locked up - Task Manager out and re-start Hazus.



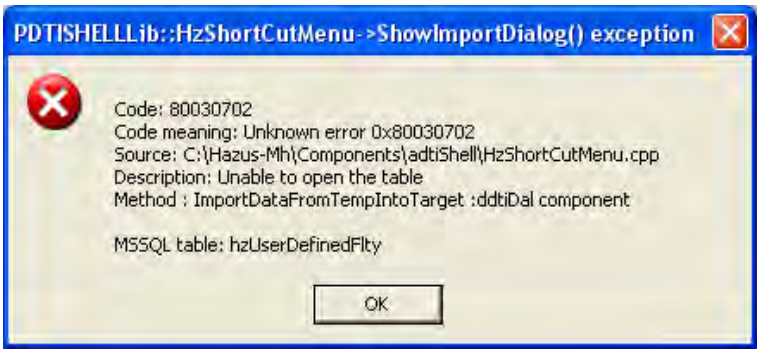
- After the import, close the User Defined Facilities attribute menu to save changes. Re-open the menu and map the results to review the imported records.
- You can only delete UDFs one page at a time. This can be slow if many records need to be deleted. Use SQL Server Management Studio (Appendix 2) to delete UDFs for loads that did not work.
  DELETE FROM dbo_hzUserDefinedFlty
  DELETE FROM dbo_flUserDefinedFlty
  Copy <Study Region>\UDS-Copy.mdb to UDS.mdb (to flush out the spatial records)
- If you do not provide the fl values during the import, the key records are created, but all the values are <Null>.
- Try to add a UDF record manually if the imports continue to fail.
- There are no "required" attributes except for Latitude and Longitude if loading from a table.
- Attempts to import directly from an ArcGIS personal GDB fail with the following error screen:



- Spatial accuracy improves when loading from a table with Lat | Lon rather than loading from a GDB. However, the spatial locations of records imported from a table to not exactly line up with the original GDB points. The UDF point locations are within +/- 5 meters of the source.



- Validation feedback is poor – there is no reporting of the data elements that cause the imports to fail.



Appendix 4 SQL Server Hints

The Study Region graphic tables are stored in an Access geodatabase and linked to attribute SQL Server tables. The Geodatabase can be maintained in ArcGIS and the SQL Server tables can be maintained using Access.

SQL DATABASE CONNECTION USING ACCESS 2003

The location of the Hazus Study Region is always on the local machine. Use REGEDIT to determine the file paths:

FEMA
Hazus
GENERAL
uid = “Hazuspuser
pwd = “goHazusplus_01
server_name = “in-polis-17\Hazusplussrvr”

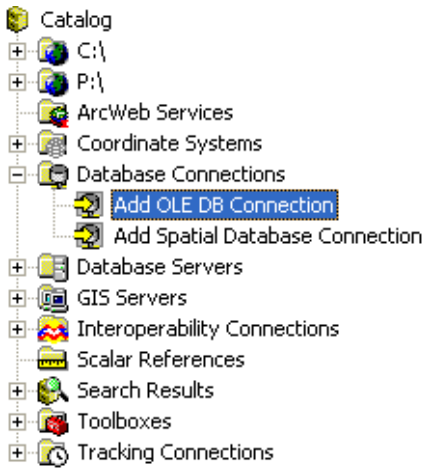
- Open Access to a new database
- New Project Using Existing Data
- Use a standard convention for a Connection Name:
  <State>_Newland_SR.adp
- Create
  1. Server Name = “in-polis-17\Hazusplussrvr”
  2. Use Specific Server Name and Password:
     User Name = “Hazuspuser”
     Password = “goHazusplus!!!
  3. Allow Password Saving
  4. Select database
     Connect either to the Study Region MDF
  5. Test Connection
  6. Save Password

SQL DATABASE CONNECTION USING ACCESS 2007

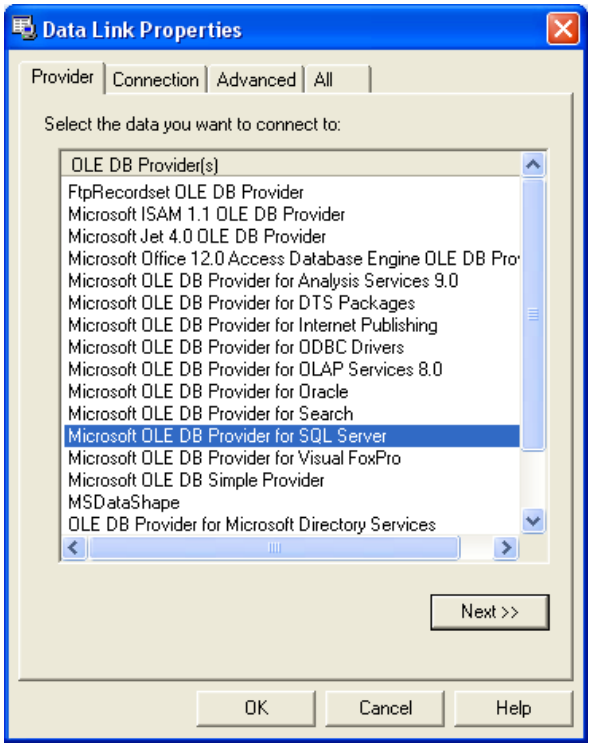
- Open Access to a new database
- External Data | More | ODBC Database
- Link to the data source by creating a linked table
- Select Data Source
  File Data Source
  New
- Create A New Data Source
  Driver
  SQL Native Client
- Name File Data Source
  <State>_Newland_SR
- SQL Server Authentication
  User Name = “Hazuspuser”
  Password = “goHazusplus_01
- Change to default database to the Study Region of interest:
  <State>_Newland_<Model>.mdf
- Rename the linked Access database saved as:
  My Documents/DatabaseX.accdb
  to:
  <State>_Newland_SR.accdb

SQL DATABASE CONNECTION USING ARCCATALOG

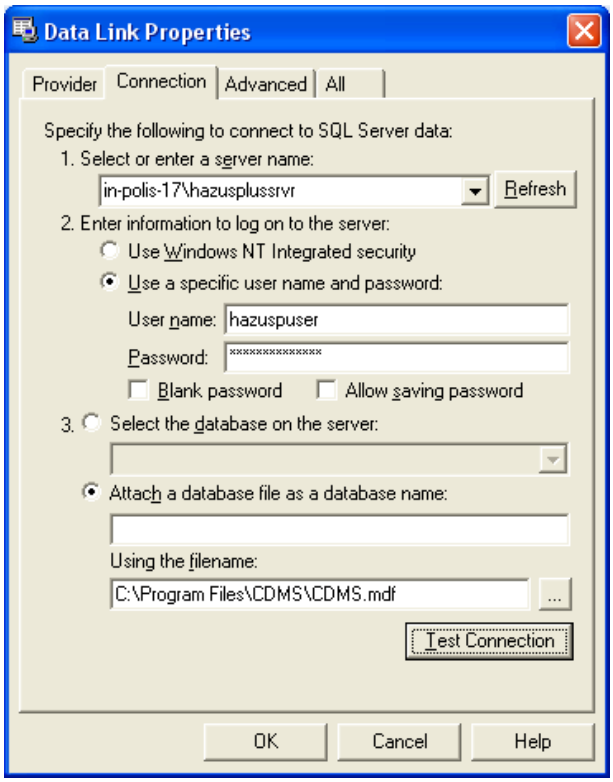
- Open ArcCatalog
- Database Connections
- Add OLE DB Connection



- Select OLE DB Provider for SQL Server

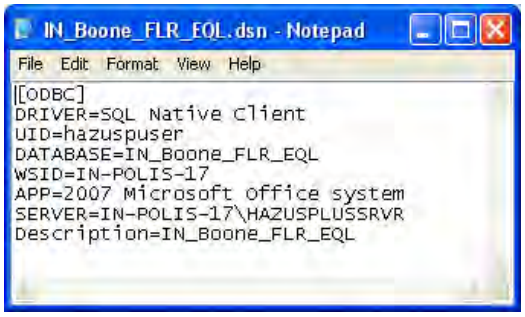

Data Link Properties
Provider
Connection
Advanced
All
Select the data you want to connect to:
OLE DB Provider(s)
FtpRecordset OLE DB Provider
Microsoft ISAM 1.1 OLE DB Provider
Microsoft Jet 4.0 OLE DB Provider
Microsoft Office 12.0 Access Database Engine OLE DB Pro
Microsoft OLE DB Provider for Analysis Services 9.0
Microsoft OLE DB Provider for DTS Packages
Microsoft OLE DB Provider for Internet Publishing
Microsoft OLE DB Provider for ODBC Drivers
Microsoft OLE DB Provider for OLAP Services 8.0
Microsoft OLE DB Provider for Oracle
Microsoft OLE DB Provider for Search
Microsoft OLE DB Provider for SQL Server
Microsoft OLE DB Provider for Visual FoxPro
Microsoft OLE DB Simple Provider
MSDataShape
OLE DB Provider for Microsoft Directory Services
Next >>
OK
Cancel
Help

- Set Data Link Properties:

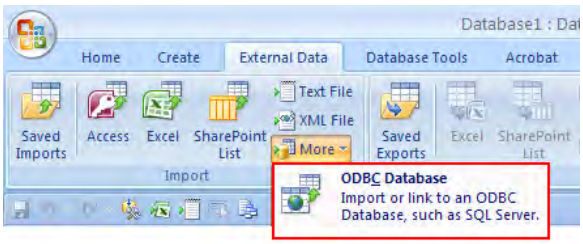


SQL DATABASE CONNECTION USING FILE DATA SOURCE

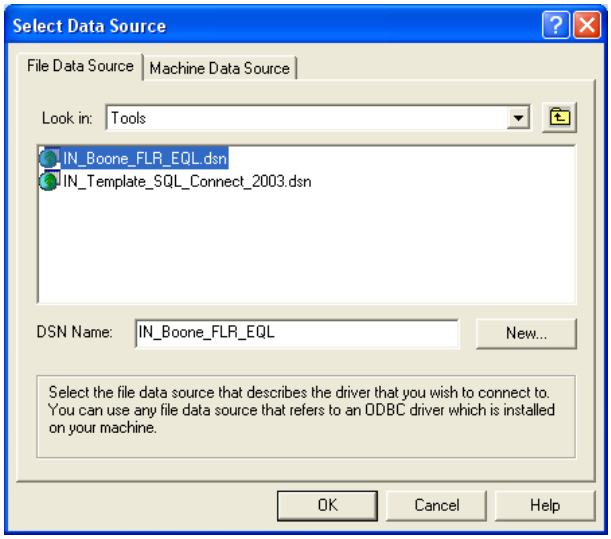
- A template file data source is available in:
  …\ND\Tools
  named
  <State>_Template_SQL_Connect_2007.dsn
- Rename the template file data source from:
  <State>_Template_SQL_Connect_2007.dsn
  to:
  <Study_Region_Name>.dsn
- Open the <Study_Region_Name>.dsn in Notepad
- Replace the DATABASE and SERVER variables to match the Study Region to be linked. Save the changes to the File Data Source.



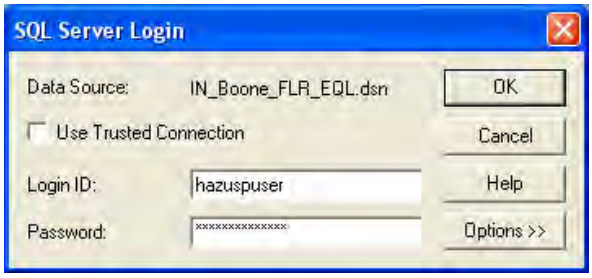
- Open Access and link to the Study Region SQL tables by External Data | More | ODBC Database.



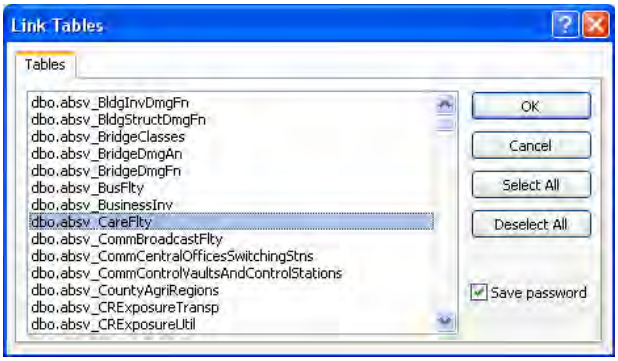
- Link to the data source by creating a linked table. Navigate to the File Data Source created previously:



- The password is "goHazusplus!!!"



- Select the Study Region SQL tables to be linked. Check the option to Save Password.

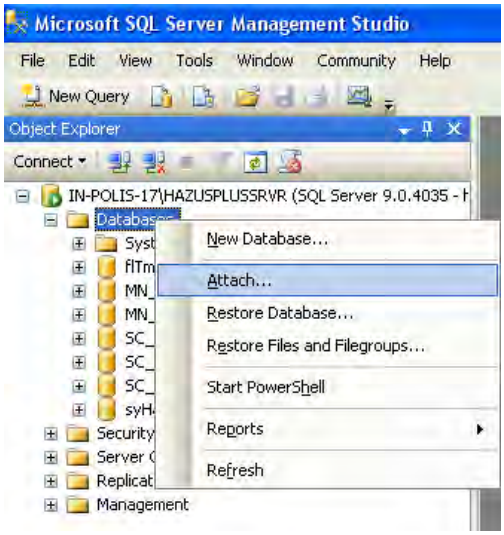


SQL USING SQL SERVER MANAGEMENT STUDIO

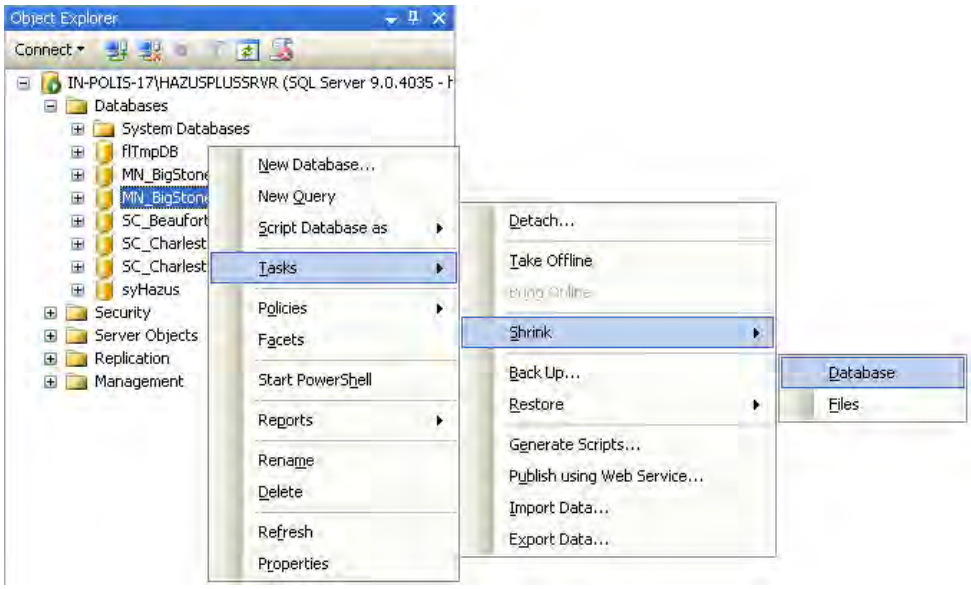
SQL Server Management Studio is the preferred environment for managing multiple Hazus PCs.

- Open SQL Server Management Studio
- Connect to a Server (usually the local PC) using SQL Server Authentication

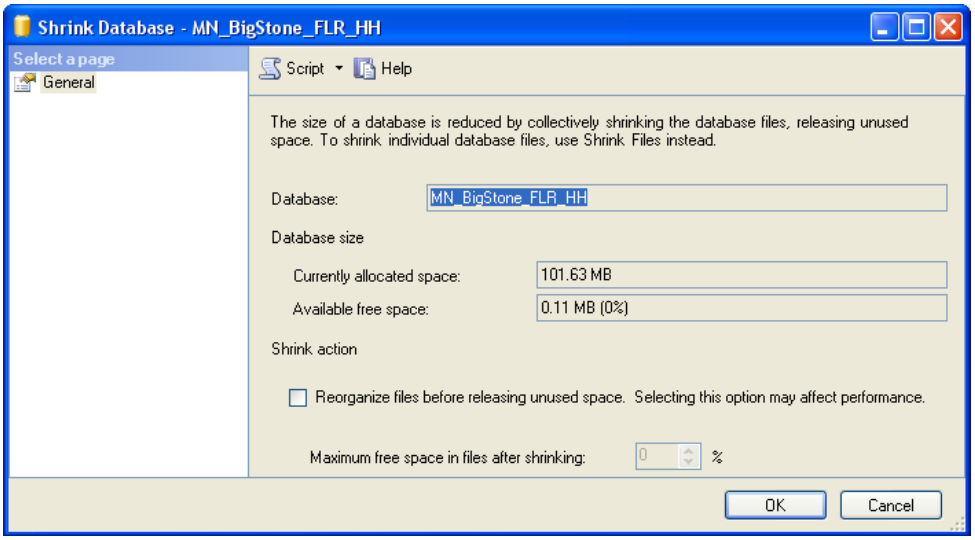
- Right-click Databases and Attach the Study Region databases residing on the Server (usually the local PC).



- Right-click the SQL database that needs to be compressed.
- Select Tasks | Shrink | Database



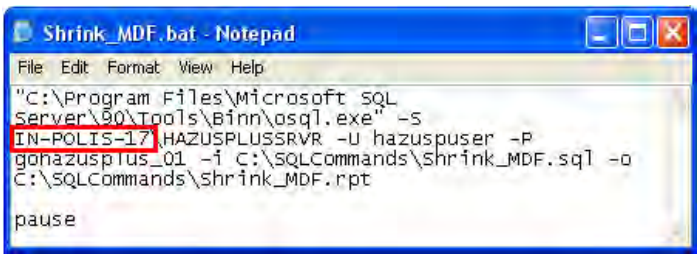
- Click OK



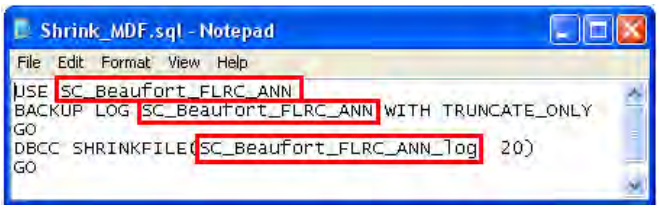
SQL USING SQL SCRIPTS

SQL scripts have been written to manage Hazus Study Region MDFs without SQL Server Management Studio. The following scripts compress the Study Region log files. It is a good practice to run these scripts before creating an HND:

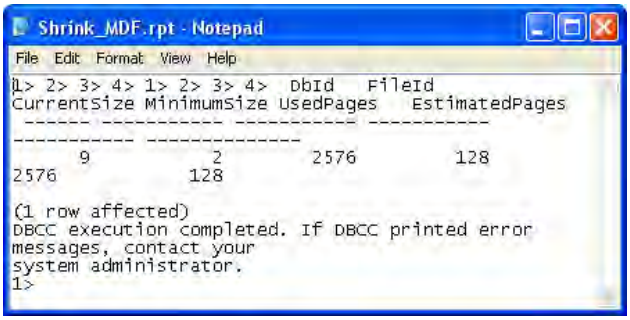
- Copy Shrink_MDF.bat and Shrink_MDF.sql to c:\SQLCommands.
- Edit Shrink_MDF.bat and enter the correct server name under the –S qualifier.


Shrink_MDF.bat - Notepad
File Edit Format View Help
"C:\Program Files\Microsoft SQL Server\90\Tools\Binn\osql.exe" -S IN-POLIS-17\HAZUSPLUSSRVR -U hazuspuser -P gohazusplus_01 -i C:\SQLCommands\Shrink_MDF.sql -o C:\SQLCommands\Shrink_MDF.rpt
pause

- Edit Shrink_MDB.sql and enter the name of the Study Region MDF database and log file that need to be compressed.



- Run Shrink_MDF.bat
- Review the results in Shrink_MDF.rpt

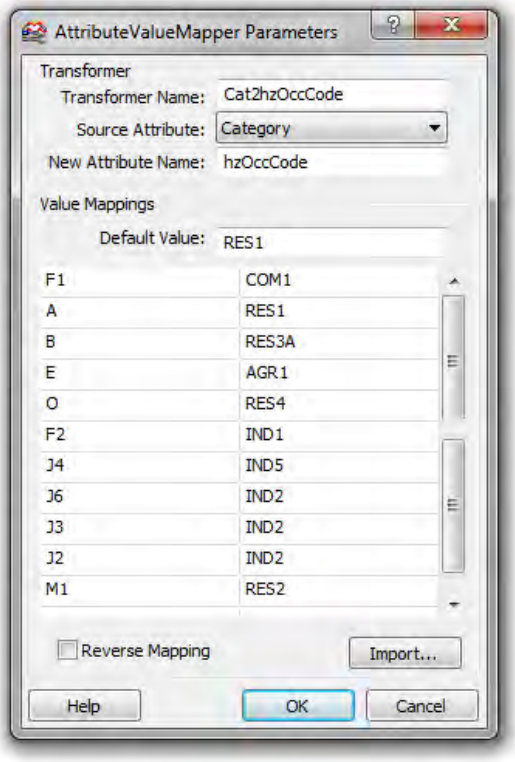

Shrink_MDF.rpt - Notepad
File Edit Format View Help
1> 2> 3> 4> 1> 2> 3> 4> DbId FileId
CurrentSize MinimumSize UsedPages EstimatedPages
9 2 2576 128
2576 128
(1 row affected)
DBCC execution completed. If DBCC printed error messages, contact your system administrator.
1>

Appendix 5 FME Algorithms For Building Inventory

The following filters and mapping schemes were applied to create Building Inventory for Newland. The 'hz' and 'fl' fields are specifically built for Hazus - hzBldgArea, hzBldgCost and hzContCost are in 1,000s. The unit for BldgValue is $s. The unit for BldgArea is sqft.

BUILDINGS TO BUILDING INVENTORY

Populate BI | Occupancy Code from Improvements | Category. Records that don't match will be defaulted to 'RES1'.



Appendix 6 FME Algorithms User Defined Facilities

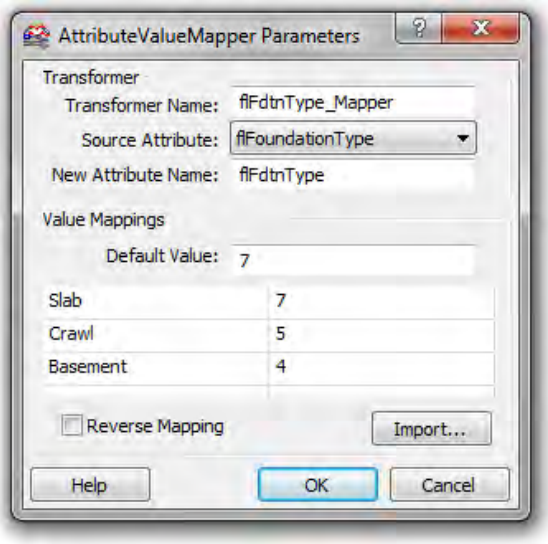
The following filters and mapping schemes were applied to create User Defined Facilities from Building Inventory.

BUILDING INVENTORY TO UDF

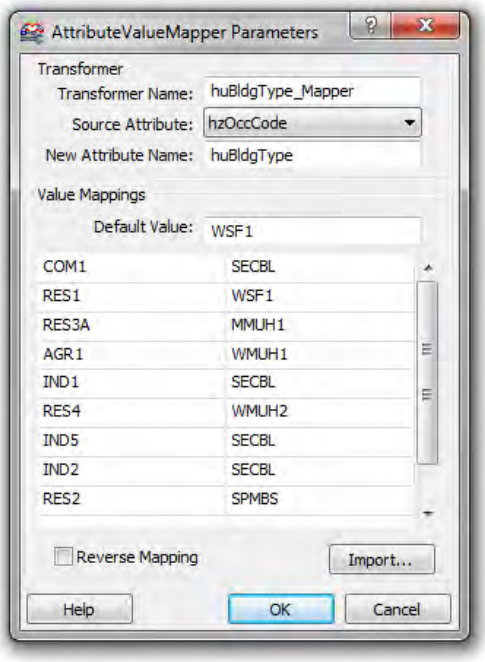
Populate UDF | fl Design Level from BI | Year Built.

Year Built	Design Level
< 1950	1
1950 – 1970	2
> 1970	3

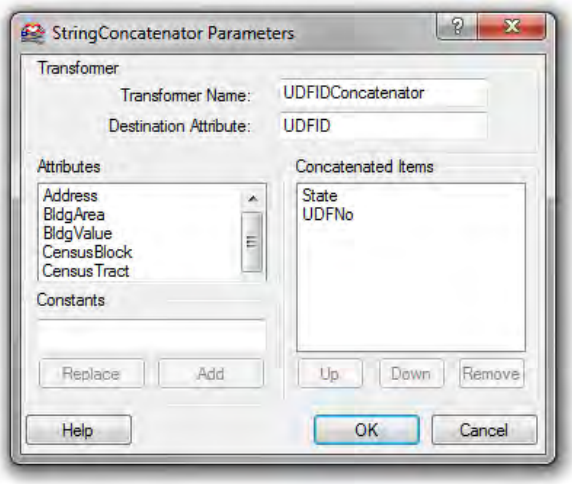
Reverse populate UDF | fl Foundation Type from BI | fl Foundation Type. The codelist value is needed in SQL AN(1), not the description.



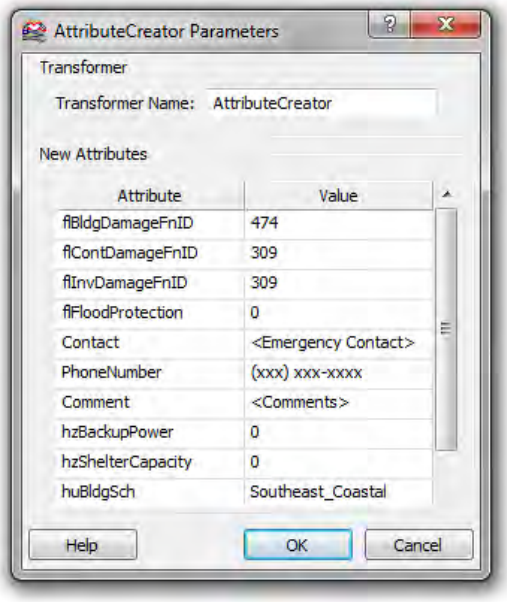
Populate UDF | hu Building Type from BI | Occupancy Code. Records that don't match will be defaulted to WSF1. [PIO] Modify to include fl Building Type matches – Wood, Steel, Concrete, Masonry or MH – The resulting matrix will be large (33 x 5).



Populate UDF | UDF ID from BI | State + Object ID. The Object ID is formatted to six characters filled with leading 0's.



Default the remaining UDF fields for which BI values do not exist.



Populate the related SQL tables using the UDF ID as the key field:

ND_Newland_UDF_SR.mdb
- hzUserDefinedFlty
- flUserDefinedFlty
- huUserDefinedFlty

…\Hazus21_Regions\ND_Newland_FLHU\UDS.mdb
- hzUserDefinedFlty